122-16-PFM

ADOPTION OF AN AMENDMENT TO
THE PUBLIC FACILITIES MANUAL
OF THE COUNTY OF FAIRFAX, VIRGINIA

At a regular meeting of the Board of Supervisors of Fairfax County, Virginia, held in the Board Auditorium of the Government Center at Fairfax, Virginia, on Tuesday, February 2, 2016, the Board after having first given notice of its intention so to do, in the manner prescribed by law, adopted an amendment to the Public Facilities Manual of the County of Fairfax, Virginia, said amendment so adopted being in the words and figures following, to-wit:

BE IT ORDAINED BY THE BOARD OF SUPERVISORS OF FAIRFAX COUNTY, VIRGINIA:

Amend the Public Facilities Manual, as follows:

Amend Chapter 6 (Storm Drainage) as follows:

Amend §6-0800 (Hydrologic Design), subsection 6-0802 (NRCS Hydrology) by revising it to read as follows:

NRCS Hydrology consists of Technical Release Number 20 (TR-20), ~~and~~ Technical Release Number 55 (TR-55), NRCS National Engineering Handbook (NEH) Part 630, and associated software applications including the COE HEC-1 and HEC-HMS software~~, NRCS applications~~. This hydrology is preferred and acceptable for all applications except where prior floodplain studies for adopted floodplains used the Anderson Formula. Supplemental Curve Number (CN) values developed for certain runoff reduction practices are provided herein. The NOAA_C 24-hour rainfall distribution shall be used with NRCS Hydrology (Plates 47A-6, 47B-6, & 48-6).

Amend §6-0800 (Hydrologic Design), subsection 6-0803 (Rational Formula) by revising the introductory paragraph to read as follows:

The Rational Formula, $Q = C_fCIA$, is acceptable for the determination of peak flows for drainage areas of 200 acres and under, except it is not authorized for designing detention/retention facilities with drainage areas greater than 20 acres. The Rational Formula (i.e. Modified Rational Method) may be used for the design of detention/retention facilities of 20 acres and less provided that the “C” factor for unimproved areas does not exceed 0.15 on storm frequencies of 2 years or less and the facility is in full compliance with all other requirements of § 6-1600 *et seq*. The product of C_f x C should not exceed 1.0.

Q = Rate of runoff (cfs)
C_f = Correction Factor for ground saturation
C = Runoff Coefficient (ratio of runoff to rainfall)
I = Rainfall Intensity (in./hr.)
A = Area of drainage basin (acres)

C_f Values
1.0 - 10-year or less
1.1 - 25-year
1.2 - 50-year
1.25 - 100-year

Amend §6-0800 (Hydrologic Design), subsection 6-0803 (Rational Formula) by revising paragraph 6-0803.2 to read as follows:

6-0803.2 Rainfall Intensity (I) shall be determined from the rainfall frequency curves shown in Plate 3A-6 or the table in Plate 3B-6 ~~Table 6.6 (for incremental unit hydrograph)~~. The 2-hour unit hydrographs in Table 6.6 and the 2-hour rainfall distributions in Table 6.18 shall be used for the design of detention facilities unless other unit hydrographs or rainfall distributions are approved by the Director as appropriate for specific applications. When using the Modified Rational Method in determining the required storage volume for detention facilities, an iterative process is normally used to determine the critical storm duration and hydrograph that results in the maximum storage volume to be detained. For ease of application and uniformity in design of detention facilities, use of the unit hydrographs in Table 6.6 replaces that iterative process. The 10-year storm frequency shall be used to design the storm drains (minor drainage systems); the 100-year storm frequency shall be used to design the drainageways of the major drainage system.

Amend §6-0800 (Hydrologic Design), subsection 6-0805 (Other Hydrologies) by revising it to read as follows:

6-0805 Other Hydrologies.

It is recognized that there are many hydrologies available, especially in the form of computer software. Other hydrologies may be approved by the Director for specific applications provided it is demonstrated that the alternatives are appropriate for the purpose intended.

6-0806 Runoff Coefficients and Inlet Times (Table 6.5)

6-080~~5~~6.1 The lowest range of runoff coefficients may be used for flat areas (areas where the majority of the grades are 2 percent and less).

6-080~~5~~6.2 The average range of runoff coefficients should be used for intermediate areas (areas where the majority of the grades are from 2 percent to 5 percent).

6-080~~5~~6.3 The highest range of runoff coefficients shall be used for steep areas (areas where the majority of the grades are greater than 5 percent), for cluster areas, and for development in clay soils areas.

Amend §6-0800 (Hydrologic Design), subsection 6-0806 (Incremental Unit Hydrograph – 1 Impervious Acre) by revising it to read as follows:

6-080~~6~~7 Incremental Unit Hydrograph – 1 ~~Impervious Acre~~ Inch of Runoff per Acre

Two-hour unit hydrographs for use with rational formula hydrology are presented in Table 6.6. To use the unit hydrographs, multiply the total rainfall amount (inches) in Table 6.19 for the 2-hour design storm by the rational formula runoff coefficient, including the correction factor for ground saturation, to obtain the runoff (inches). Multiply the runoff (inches) by the unit hydrograph values in Table 6.6 and the drainage area (acres) to generate the hydrograph values (cfs) for the design storm.

Amend §6-0800 (Hydrologic Design), Table 6.6 (Incremental Unit Hydrograph Intensities-Inches/Hour) by revising it to read as follows:

Table 6.6 Incremental Unit Hydrograph Intensities-Inches/Hour

TIME (Minute)	t_c=5 Minute				t_c=10 Minute				t_c=15 Minute			
	2-YR	10-YR	25-YR	100-YR	2-YR	10-YR	25-YR	100-YR	2-YR	10-YR	25-YR	100-YR
5	5.45	7.27	8.27	9.84	2.57	3.25	3.42	3.68	1.65	2.20	2.44	2.81
10	3.51	4.68	5.34	6.37	4.60	5.92	6.77	8.10	3.18	4.24	5.92	5.99
15	2.60	3.46	3.95	4.73	3.40	4.53	5.29	6.47	3.90	5.10	5.86	7.05
20	2.08	2.77	3.15	3.74	2.36	3.14	3.65	4.44	3.27	4.36	4.88	5.69
25	1.72	2.29	2.62	3.13	1.82	2.43	2.85	3.50	2.31	3.08	3.40	3.89
30	1.46	1.94	2.23	2.65	1.49	1.99	2.33	2.86	1.76	2.34	2.66	3.17
35	1.28	1.68	1.93	2.33	1.25	1.67	2.97	2.43	1.42	1.89	2.22	2.73
40	1.10	1.47	1.70	2.07	1.06	1.41	1.71	2.17	1.17	1.56	1.89	2.40
45	1.00	1.31	1.53	1.88	0.91	1.21	1.49	1.93	0.97	1.29	1.63	2.16
50	0.89	1.18	1.38	1.69	0.78	1.04	1.33	1.78	0.80	1.07	1.42	1.98
55	0.82	1.08	1.26	1.55	0.69	0.92	1.21	1.67	0.67	0.89	1.26	1.83
60	0.74	0.99	1.16	1.42	0.60	0.80	1.10	1.58	0.55	0.73	1.10	1.68
65	0.68	0.91	1.06	1.30	0.55	0.73	1.01	1.45	0.50	0.67	1.01	1.54
70	0.62	0.83	0.97	1.18	0.50	0.67	0.92	1.32	0.46	0.61	0.92	1.40
75	0.56	0.74	0.87	1.07	0.45	0.60	0.83	1.19	0.41	0.55	0.83	1.26
80	0.49	0.66	0.77	0.95	0.40	0.53	0.73	1.05	0.37	0.49	0.73	1.12
85	0.43	0.58	0.68	0.83	0.35	0.47	0.64	0.92	0.32	0.43	0.64	0.98
90	0.37	0.50	0.58	0.71	0.30	0.40	0.55	0.79	0.28	0.37	0.55	0.84
95	0.31	0.41	0.48	0.59	0.25	0.33	0.46	0.66	0.23	0.30	0.46	0.70
100	0.25	0.33	0.39	0.47	0.20	0.27	0.37	0.53	0.18	0.24	0.37	0.56
105	0.19	0.25	0.29	0.36	0.15	0.20	0.28	0.40	0.14	0.18	0.28	0.42
110	0.12	0.17	0.19	0.24	0.10	0.13	0.18	0.26	0.09	0.12	0.18	0.28
115	0.06	0.08	0.10	0.12	0.05	0.07	0.09	0.13	0.05	0.06	0.09	0.14
120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6.6 (cont'd) Incremental Unit Hydrograph Intensities-Inches/Hour

TIME (Minute)	t_c=20 Minute				t_c=25 Minute				t_c=30 Minute			
	2-YR	10-YR	25-YR	100-YR	2-YR	10-YR	25-YR	100-YR	2-YR	10-YR	25-YR	100-YR
5	1.49	1.98	1.77	1.43	0.96	1.28	1.16	0.98	0.60	0.80	0.87	0.97
10	2.53	3.37	3.37	3.36	1.80	2.40	2.35	2.26	1.18	1.57	1.69	1.88
15	3.15	4.20	4.64	5.33	2.44	3.25	3.46	3.79	1.74	2.32	2.51	2.80
20	3.42	4.56	5.25	6.32	2.87	3.83	4.31	5.05	2.25	3.00	3.31	3.79
25	3.12	4.16	4.55	5.15	3.02	4.03	4.70	5.75	2.64	3.52	3.99	4.73
30	2.27	3.02	3.32	3.78	2.92	3.89	4.39	5.17	2.76	3.71	4.30	5.22
35	1.67	2.22	2.54	3.03	2.51	3.35	3.60	3.99	2.61	3.48	3.99	4.78
40	1.37	1.83	2.11	2.55	2.01	2.68	2.77	2.90	2.27	3.03	3.38	3.92
45	1.19	1.58	1.83	2.23	1.54	2.05	2.14	2.28	1.87	2.49	2.70	3.04
50	1.06	1.41	1.64	2.00	1.19	1.58	1.73	1.96	1.48	1.97	2.18	2.52
55	0.95	1.27	1.50	1.87	0.97	1.29	1.48	1.77	1.19	1.58	1.82	2.20
60	0.88	1.17	1.40	1.75	0.84	1.12	1.33	1.65	0.99	1.32	1.57	1.97
65	0.81	1.07	1.28	1.60	0.77	1.03	1.22	1.51	0.91	1.21	1.44	1.81
70	0.73	0.98	1.17	1.46	0.70	0.93	1.11	1.38	0.83	1.10	1.31	1.64
75	0.66	0.88	1.05	1.31	0.63	0.84	1.00	1.24	0.74	0.99	1.18	1.48
80	0.59	0.78	0.93	1.17	0.56	0.75	0.89	1.10	0.66	0.88	1.05	1.31
85	0.51	0.68	0.82	1.02	0.49	0.65	0.78	0.96	0.58	0.77	0.92	1.15
90	0.44	0.59	0.70	0.88	0.42	0.56	0.67	0.83	0.50	0.66	0.79	0.99
95	0.37	0.49	0.58	0.73	0.35	0.47	0.55	0.69	0.41	0.55	0.65	0.82
100	0.29	0.39	0.47	0.58	0.28	0.37	0.44	0.55	0.33	0.44	0.52	0.66
105	0.22	0.29	0.35	0.44	0.21	0.28	0.33	0.41	0.25	0.33	0.39	0.49
110	0.15	0.20	0.23	0.29	0.14	0.19	0.22	0.28	0.17	0.22	0.26	0.33
115	0.07	0.10	0.12	0.15	0.07	0.09	0.11	0.14	0.08	0.11	0.13	0.16
120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6.6 Incremental Unit Hydrograph CFS

TIME (Minute)	t_c=5 Minute	t_c=10 Minute	t_c=15 Minute	t_c=20 Minute	t_c=25 Minute	t_c=30 Minute
5	2.451	1.103	0.754	0.540	0.359	0.259
10	1.582	2.127	1.579	1.003	0.714	0.505
15	1.171	1.638	1.805	1.353	1.036	0.749
20	0.934	1.132	1.506	1.517	1.275	0.984
25	0.775	0.881	1.052	1.328	1.382	1.179
30	0.658	0.721	0.819	0.969	1.299	1.262
35	0.574	0.608	0.676	0.735	1.075	1.176
40	0.502	0.525	0.571	0.610	0.833	1.002
45	0.453	0.456	0.488	0.530	0.643	0.807
50	0.407	0.403	0.421	0.473	0.515	0.649
55	0.373	0.365	0.367	0.432	0.436	0.537
60	0.341	0.329	0.317	0.401	0.389	0.460
65	0.313	0.301	0.290	0.368	0.357	0.422
70	0.285	0.275	0.265	0.335	0.325	0.384
75	0.256	0.247	0.238	0.301	0.292	0.345
80	0.227	0.219	0.212	0.268	0.260	0.307
85	0.199	0.192	0.185	0.234	0.227	0.269
90	0.171	0.164	0.160	0.201	0.195	0.231
95	0.142	0.137	0.132	0.168	0.162	0.191
100	0.114	0.110	0.105	0.133	0.129	0.153
105	0.086	0.083	0.080	0.100	0.097	0.115
110	0.057	0.054	0.052	0.067	0.065	0.077
115	0.028	0.027	0.027	0.034	0.032	0.038
120	0.000	0.000	0.000	0.000	0.000	0.000

Amend §6-1000 (Open Channels), subsections 6-1009 (Example – Paved Ditch Computations), 6-1010 (Example – Paved Ditch Computations), and 6-1011 (Example – Paved Ditch Computations) by revising them to read as follows:

6-1009 Example – ~~Paved~~ <u>Roadside</u> Ditch Computations.

<u>Example based on the VDOT method for design of roadside ditches (See VDOT Drainage Manual). The Rational Formula is used to determine the flow in each ditch segment beginning with the most upstream segment and proceeding downstream. To calculate the flow in each successive downstream segment, the Rational Formula CA values from all the upstream segments are added to the CA value for the segment being analyzed. The rainfall intensity for the segment being analyzed is the lesser of the rainfall intensity for that segment or the rainfall intensity of the previous segment minus 0.1 in/hr. This is a simplifying assumption or approximation of the actual rainfall intensity that is used for computational efficiency. If the computed flow in any segment decreases from the previous segment, the flow is held at the higher value until the flow for the next segment increases. After computing the flows, determine the velocities, depth of flow, and the need for channel linings in accordance with § 6-1002.</u>
Given or assumed ~~(~~values <u>below</u> vary with projects~~):~~<u>.</u>

6-1009.1 Q=CIA

Where:
C=0.9 for paved area
C=0.5 for unpaved drainage area within normal rights-of-way
C=0.3 for drainage area outside normal rights-of-way <u>(ROW)</u>

“I” is based on the 2-year rainfall curve with time of concentration dependent upon average width, grade and type of cover, (5 percent and average grass in this case).

$$A = \frac{100 \text{ x Width Strip}}{43,560}$$

Where:
A = area (acres)
Width Strip = width (ft.)
<u>Length of ditch segment = 100 feet</u>

6-1009.2 Typical Section: 24-foot pavement, <u>road is crowned and 12 feet of pavement drains to ditch,</u> ditch having 3:1 front slope and 2:1 back slope.

6-1009.3 (91-06-PFM) From “Virginia Erosion and Sediment Control Handbook,” Chapter 5, mostly silt loam with a short section of ordinary firm load.

6-1009.4 (91-06-PFM) Allowable Velocity: From Table 5-22 in the “Virginia Erosion and Sediment Control” use 3 fps as permissible velocity for silt loam and 3.5 fps for ordinary firm loam.

6-1009.5 Normal right-of-way width = ~~110~~ <u>50</u> feet.

6-1009.6 Width Strip Drained: To be determined from cross-sections, aerial photographs, topographical sheets or field observation (to be measured from outside edge of ~~pavement~~ of the ROW to the nearest multiple of 10 feet).

6-1009.7 (61-98-PFM) Where vegetative linings are used, n=0.050 should be used and a velocity of 4 fps should be the upper permitted maximum.

6-1010 Example – ~~Paved~~ Roadside Ditch Computations (continued).

~~"C" "A"~~ "CA" Values for 100 feet of ditch, using various widths ~~and roughness factors~~.

		~~**Col. 1 No Pavement**~~	~~**Col. 1 + 0.025* 12 ft. Pavement**~~	~~**Col. 1 + 0.050** 24 ft. Pavement**~~	
~~30 x 100 x 0.5 / 43,560~~	=	~~0.035~~	~~0.060~~	~~0.085~~	~~***12 ft. Pavement Computations**~~
~~40 x 100 x 0.5 / 43,560~~	=	~~0.046~~	~~0.071~~	~~0.096~~	~~**12 x 100 x 0.9 / 43,560 = 0.025**~~
~~60 x 100 x 0.48 / 43,560~~	=	~~0.066~~	~~0.091~~	~~0.116~~	
~~100 x 100 x 0.41 / 43,560~~	=	~~0.094~~	~~0.119~~	~~0.144~~	~~****24 ft. Pavement Computations**~~
~~150 x 100 x 0.37 / 43,560~~	=	~~0.128~~	~~0.153~~	~~0.178~~	~~**24 x 100 x 0.9 / 43,560 = 0.050**~~
~~200 x 100 x 0.35 / 43,560~~	=	~~0.161~~	~~0.186~~	~~0.211~~	

~~Note: See § 6-1002 and VDOT Drainage Manual.~~

Width of strip outside ROW	**CA unpaved area outside ROW**		**CA unpaved area in ROW**		**CA pavement in ROW**		**CA Total**
W	W x 100 x 0.3 / 43,560		13 x 100 x 0.5 / 43,560		12 x 100 x 0.9 / 43,560		
30	0.021	+	0.015	+	0.025	=	0.061
40	0.028	+	0.015	+	0.025	=	0.068
60	0.041	+	0.015	+	0.025	=	0.081
100	0.069	+	0.015	+	0.025	=	0.109
150	0.103	+	0.015	+	0.025	=	0.143
200	0.138	+	0.015	+	0.025	=	0.178

From 2-year Curve – RAINFALL										
Duration (minutes)	6	7	8	9	10	11	12	13	14	15
Intensity	~~4.8~~	~~4.6~~	~~4.4~~	~~4.3~~	~~4.1~~	4.0	3.9	~~3.7~~	3.6	3.5
	5.0	4.7	4.5	4.4	4.2			3.8		

~~**Table 6.17 Time of Concentration to Use – Paved Ditch**~~

~~30 ft.~~	~~Width Strip~~	~~-~~	~~t_c~~	~~6 minutes,~~	~~I 4.8 in./hr.~~
~~40 ft.~~	~~Width Strip~~	~~-~~	~~t_c~~	~~7 minutes,~~	~~I 4.6 in./hr.~~
~~60 ft.~~	~~Width Strip~~	~~-~~	~~t_c~~	~~9 minutes,~~	~~I 4.3 in./hr.~~
~~100 ft.~~	~~Width Strip~~	~~-~~	~~t_c~~	~~10 minutes,~~	~~I 4.1 in./hr.~~
~~150 ft.~~	~~Width Strip~~	~~-~~	~~t_c~~	~~12 minutes,~~	~~I 3.9 in./hr.~~
~~200 ft.~~	~~Width Strip~~	~~-~~	~~tc~~	~~14 minutes,~~	~~I 3.6 in./hr.~~

Table 6.17 Time of Concentration to Use* – Roadside Ditch

Width of strip outside ROW feet	**Time of concentration (t_c) minutes**	**Rainfall intensity (I) in./hr.**
30	6	5.0
40	7	4.7
60	9	4.4
100	10	4.2
150	12	3.9
200	14	3.6

* Time of Concentration is based on Plate 4-6.

6-1011 Example – ~~Paved~~ Roadside Ditch Computations (continued). ~~Decrease "I" value 0.1 in./hr. for each additional 100 feet that water flows in the ditch.~~

~~Time of Concentration is based on Plate 4-6.~~

COMPUTATIONS

Sta. 136 + 00 to 142 + 00 (Ditch #1) and Sta. 149 + 50 to 157 + 50 (Ditch #2)

Check Point	Width of strip Outside ROW	CA segment	CA total	I	(CA) x I = Q
Ditch #1					
Sta. 136+00					
	30 feet	0.061	0.061	5.0 in/hr	0.061 x 5.0 = 0.3050 cfs
Sta. 137+00		~~0.060~~			~~0.060 x 4.8 = 0.2880 cfs~~
	40 feet	0.068	0.129	4.7 in/hr	0.129 x 4.7 = 0.6063 cfs

Sta. 138+00		~~0.071/0.131~~			~~0.131 x 4.6 = 0.6026 cfs~~
	100 feet	0.109	0.238	4.2 in/hr	0.238 x 4.2 = 0.9996 cfs
Sta. 139+00		~~0.119/0.250~~			~~0.250 x 4.1 = 1.0250 cfs~~
	100 feet	0.109	0.347	4.1 in/hr	0.347 x 4.1 = 1.4227 cfs
Sta. 140+00		~~0.119/0.369~~			~~0.369 x 4.0 = 1.4760 cfs~~
	40 feet	0.068	0.413	4.0 in/hr	0.413 x 4.0 = 1.6520 cfs
Sta. 141+00		~~0.071/0.440~~			~~0.440 x 3.9 = 1.7160 cfs~~
	40 feet	0.068	0.481	3.9 in/hr	0.481 x 3.9 = 1.8759 cfs
Sta. 142+00		~~0.071/0.511~~			~~0.511 x 3.8 = 1.9418 cfs~~

Ditch #2

Sta. 157+ 50					
	40 feet	0.068	0.068	4.7 in/hr	0.068 x 4.7 = 0.3196 cfs
Sta. 156+50		~~0.096~~			~~0.096 x 4.6 = 0.6228 cfs~~
	60 feet	0.081	0.149	4.4 in/hr	0.149 x 4.4 = 0.6556 cfs
Sta. 155+50		~~0.116/0.212~~			~~0.212 x 4.3 = 0.9116 cfs~~
	100 feet	0.109	0.258	4.2 in/hr	0.258 x 4.2 = 1.0836 cfs
Sta. 154+50		~~0.144/0.356~~			~~0.356 x 4.1 = 1.4596 cfs~~
	200 feet	0.178	0.436	3.6 in/hr	0.436 x 3.6 = 1.5696 cfs
Sta. 153+50		~~0.211/0.567~~			~~0.567 x 3.6 = 2.0412 cfs~~
	200 feet	0.178	0.614	3.5 in/hr	0.614 x 3.5 = 2.1490 cfs
Sta. 152+50		~~0.211/0.778~~			~~0.778 x 3.5 = 2.7230 cfs~~
	150 feet	0.143	0.757	3.4 in/hr	0.757 x 3.4 = 2.5738 cfs
Sta. 151+50		~~0.178/0.956~~			~~0.956 x 3.4 = 3.2504 cfs~~
	100 feet	0.109	0.866	3.3 in/hr	0.866 x 3.3 = 2.8578 cfs
Sta. 150+50		~~0.119/1.075~~			~~1.075 x 3.3 = 3.5475 cfs~~
	60 feet	0.081	0.947	3.2 in/hr	0.947 x 3.2 = 3.0304 cfs
Sta. 149+50		~~0.091/1.166~~			~~1.166 x 3.2 = 3.7312 cfs~~

Amend §6-1300 (Retention, Detention, and Low Impact Development Facilities), subsection 6-1302 (Rooftop Storage) by revising it to read as follows:

6-1302 Rooftop Storage

6-1302.1 Rooftop storage shall be designed to meet the water quantity control requirements of the Storm Water Management Ordinance ~~detain the 10-year, 2-hour storm, and emergency overflow provisions must be adequate to discharge the 100-year, 30-minute storm (See § 6-1302.5 and Tables 6.18 and 6.19)~~.

6-1302.2 ~~(116-14-PFM)~~ The roof drainage system shall be designed in accordance with the Uniform Statewide Building Code, including emergency overflow requirements ~~If a proper design is submitted for the 10-year storm, sufficient storage will normally be provided for the 2-year storm and the 1-year storm, and separate calculations need not be made~~.

6-1302.3 ~~Rainfall from this design storm results in an accumulated storage depth of 3 inches.~~ The roof shall be designed to address the live load requirements of the Uniform Statewide Building Code taking into consideration the maximum water surface elevation produced by the design storm for emergency overflow.

~~6-1302.3A Because roof design in the County is currently based on a snow load of 30 PSF or 5.8 inches of water, properly designed roofs are structurally capable of holding 3 inches of detained stormwater with a reasonable factor of safety.~~

~~6-1302.3B Roofs calculated to store depths greater than 3 inches shall be required to show structural adequacy of the roof design.~~

~~6-1302.4 No less than two roof drains shall be installed in roof areas of 10,000 square feet or less, and at least four drains in roof areas over 10,000 square feet in area. Roof areas exceeding 40,000 square feet shall have one drain for each 10,000 square feet area.~~

~~6-1302.5 Emergency overflow measures adequate to discharge the 100-year, 30-minute storm must be provided.~~

~~6-1302.5A If parapet walls exceed 3 inches in height, the designer shall provide openings (scuppers) in the parapet wall sufficient to discharge the design storm flow at a water level not exceeding 5 inches.~~

~~6-1302.5B One scupper shall be provided for every 20,000 square feet of roof area, and the invert of the scupper shall not be more than 3½ inches above the roof level. If such openings are not practical, then detention rings shall be sized accordingly.~~

6-1302.~~6~~4 Detention rings shall be placed around all roof drains that do not have controlled flow.

6-1302.~~6~~4A The number of holes or size of openings in the rings shall be computed based on the area of roof drained and runoff criteria.

6-1302.~~6~~4B The minimum spacing of sets of holes is 2 inches center-to-center.

6-1302.~~6~~4C The height of the ring is determined by the roof slope and shall be ~~3~~ 2.56 inches maximum.

6-1302.~~6~~4D The diameter of the rings shall be sized to accommodate the required openings and, if scuppers are not provided, to allow the ~~100-year~~ emergency overflow design storm to overtop the ring (overflow design is based on weir computations with the weir length equal to the circumference of the detention ring).

~~6-1302.6E Conductors and leaders shall also be sized to pass the expected flow from the 100-year design storm.~~

6-1302.7 The maximum time of drawdown on the roof shall not exceed ~~17~~ 24 hours for the 10-year design storm.

6-1302.8 Josam Manufacturing Company and Zurn Industries, Inc. market “controlled-flow” roof drains. These products, or their equivalent, are accepted by the County.

6-1302.9 Computations required on plans:

6-1302.9A Roof area in square feet

6-1302.9B Storage provided at ~~3~~ 2.56 inches depth

6-1302.9C Maximum allowable discharge rate

6-1302.9D Inflow-outflow hydrograph analysis or acceptable charts. (For Josam Manufacturing Company and Zurn Industries, Inc. standard drains, the peak discharge rates as given in their charts are acceptable for drainage calculation purposes without requiring full inflow-outflow hydrograph analysis.)

6-1302.9E Number of drains required

6-1302.9F Sizing of openings required in detention rings

6-1302.9G Sizing of ring to accept openings and to pass ~~100-year~~ the emergency overflow design storm

6-1302.10 Example:

Given:

Building with flat roof 200 feet x 50 feet~~,~~;
Pre-development coefficient of runoff~~:~~, ~~c~~C = 0.40;
Post-development coefficient of runoff, C = 0.9;
Pre-development time of concentration, t_c = 10 minutes;
Post-development time of concentration, t_c = 5 minutes;
Pre-development rainfall intensity for a 10-year storm with a t_c = 10 minutes, I = 5.45 in/hr;
Post-development rainfall intensity for a 100-year storm with a t_c = 5 minutes, I = 9.1 in/hr;
Total rainfall for a 2-hour 10-year storm is 2.56 inches.

Computations:

6-1302.10A Roof Area = 200 ft. x 50 ft. = 10,000 ft^2

6-1302.10B Storage provided at ~~3~~ 2.56 inches of depth: Vol. = (10,000 ft^2)(~~3~~ 2.56 in.)(1/12) = ~~2,500~~ 2133.33 ft^3

6-1302.10C Maximum allowable discharge (pre-development rate of runoff) for the 10-year storm

Q = CIA = (0.4)(~~5.92~~ 5.45)~~(927.2/.093)~~(10,000/43,560)
Q = ~~0.54~~ 0.50 cfs

6-1302.10D From Plate 37-6, One set of holes with ~~3~~ <u>2.56</u> inches of water will ~~produce runoff or~~ <u>have a</u> discharge of ~~6~~ <u>5.12</u> gpm or ~~0.0134~~ <u>0.0113</u> cfs. See Plate 38-6 for a diagram of a typical ponding ring.

6-1302.10E Number of drains required for 10,000 square feet roof area ~~equals~~ <u>under the Uniform Statewide Building Code is</u> two.

6-1302.10F Sizing of openings:

<u>Allowable discharge per drain = 0.50 cfs/2 = 0.25 cfs</u>
Number of hole sets = allowable discharge divided by ~~0.0134~~ <u>0.0113</u> cfs/one set of holes
~~Number of holes = 0.54 cfs/two drains~~
~~0.0134 cfs/one set of holes~~
~~20.1 sets of holes per drain (use 20 sets of holes)~~
<u>Number of hole sets = 0.25 cfs /0.0113 cfs = 22.1 sets of holes per drain (use 22 sets of holes)</u>

6-1302.10G Size of ring:

Hole sets spaced 2 inches on center
Circumference = ~~B~~ <u>π</u> x diameter
(~~20~~ <u>22</u> sets) (2 inches/set) = ~~B~~ <u>π</u> x diameter
D = ~~12.73~~ <u>14.01</u> inches, use 15 inches (see below if separate emergency overflow is not provided).

6-1302.11 If detention rings are to act as emergency overflow measures <u>and assuming a 100-year design storm</u>:

Q100=CIA; t_c = 5 minutes; C = 1.0 <u>(including correction factor for 100-year frequency storm)</u>;
A = 10,000 ft^2/43,560 = 0.23 ac.
Q100 = (1.0)(~~9.84~~ <u>9.10</u>)(0.23 ac.) = ~~2.26~~ <u>2.09</u> cfs <u>(use 1.045 cfs per drain)</u>

Weir formula: $Q = CLH^{3/2}$
C = 3.33
L = ~~B~~ <u>π</u>D (circumference)
H = ~~2 in. or 0.17 ft.~~ <u>2.56 in. or 0.21 ft.</u>

Assume all hole sets are clogged and the maximum allowable water depth on the roof is 5 inches, or 2<u>.44</u> inches above the ~~3~~<u>2.56</u>-inch high ring.

$Q = CLH^{3/2}$
Q (per drain) = ~~2.26~~ <u>1.045</u> cfs = 3.33 ~~B~~ <u>π</u>D(~~0.17~~<u>0.21</u>)$^{3/2}$

D = ~~3.08 ft. or 36.98 in.~~ <u>1.04 ft. or 12.46 in.</u>
Use diameter of ~~37~~ <u>15</u> inches

Amend §6-1300 (Retention, Detention, and Low Impact Development Facilities), subsection 6-1305 (Retention and Detention Ponds), paragraph 1305.9 by revising it to read as follows:

6-1305.9 Table 6.6 ~~and Plate 40-6~~ shows inflow hydrographs for various 10-year, 2-hour storms with times of concentration from 5 minutes to 30 minutes.

Amend §6-1300 (Retention, Detention, and Low Impact Development Facilities), Table 6.18 (Rainfall Distribution) and Table 6.19 (Storm Volume in Inces of Rainfall), by revising them to read as follows:

Table 6.18 Rainfall Distribution

Time minutes	Total Precip in.	Total Precip ft.	Increm Precip in.	Increm Precip ft.
		1-Year, 2-Hour Storm		
5	.36	.030	.36	.03
10	.57	.047	.21	.018
15	.71	.059	.14	.012
20	.81	.067	.10	.008
30	.97	.081	.16	.014
40	1.06	.089	.09	.008
50	1.14	.095	.08	.007
60	1.21	.101	.07	.006
70	1.25	.105	.04	.004
80	1.29	.108	.04	.003
90	1.33	.111	.04	.003
100	1.36	.113	.03	.003
110	1.39	.116	.03	.003
120	1.42	.119	.03	.002
		2-Year, 2-Hour Storm		
5	.44	.036	.44	.036
10	.70	.058	.26	.022
15	.88	.073	.18	.015
20	1.01	.084	.13	.011
30	1.20	.100	.19	.016
40	1.34	.112	.14	.011
50	1.44	.120	.10	.009
60	1.53	.127	.08	.007
70	1.57	.131	.04	.004
80	1.61	.134	.04	.003
90	1.65	.137	.04	.003
100	1.68	.140	.03	.003
110	1.71	.142	.03	.003
120	1.74	.145	.03	.002
		10-Year, 2-Hour Storm		
5	~~.60~~ .56	~~.05~~ .047	~~.60~~ .56	~~.05~~ .047
10	~~.99~~ .91	~~.083~~ .076	~~.39~~ .34	~~.032~~ .029
15	~~1.28~~ 1.15	~~.107~~ .096	~~.29~~ .25	~~.024~~ 0.20
20	~~1.52~~ 1.34	~~.127~~ .112	~~.24~~ .19	~~.020~~ .016
30	~~1.85~~ 1.63	~~.154~~ .136	~~.33~~ .29	~~.027~~ .024
40	~~2.11~~ 1.84	~~.176~~ .154	~~.26~~ .21	~~.022~~ .018
50	~~2.33~~ 2.01	~~.194~~ .168	~~.22~~ .17	~~.018~~ .014
60	~~2.50~~ 2.16	~~.208~~ .180	~~.17~~ .14	~~.014~~ .012
70	~~2.62~~ 2.24	~~.218~~ .187	~~.12~~ .08	~~.010~~ .007
80	~~2.72~~ 2.32	~~.226~~ .193	~~.10~~ .08	~~.008~~ .006

90	~~2.82~~ 2.38	~~.235~~ .199	~~.10~~ .07	~~.008~~ .006
100	~~2.89~~ 2.45	~~.241~~ .204	~~.07~~ .06	~~.006~~ .005
110	~~2.95~~ 2.51	~~.246~~ .209	~~.06~~ .06	~~.005~~ .005
120	~~3.00~~ 2.56	~~.250~~ .213	~~.05~~ .05	~~.004~~ .005
100-Year, ~~30 Minute~~ 2-Hour Storm				
5	~~1.11~~ 0.76	~~.093~~ .063	~~1.11~~ .76	~~.093~~ .063
10	~~1.71~~ 1.21	~~.143~~ .101	~~.60~~ .46	~~.050~~ .038
15	~~2.16~~ 1.55	~~.179~~ .129	~~.45~~ .34	~~.036~~ .028
20	~~2.46~~ 1.83	~~.204~~ .153	~~.30~~ .28	~~.025~~ .023
30	~~3.00~~ 2.28	~~.250~~ .190	~~.54~~ .45	~~.046~~ .038
40	2.65	.221	.37	.031
50	2.97	.247	.32	.026
60	3.25	.271	.28	.023
70	3.39	.283	.14	.012
80	3.52	.293	.13	.011
90	3.64	.303	.12	.010
100	3.75	.312	.11	.009
110	3.85	.321	.10	.008
120	3.94	.328	.09	.008

Table 6.19 Storm Volume in Inches of Rainfall*

Duration of Storm

Frequency	5 Min	10 Min	15 Min	30 Min~~ute~~	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr
1 Yr	0.355	0.567	0.708	~~1.0~~ 0.971	~~1.4~~ 1.21	~~1.7~~ 1.42	~~1.8~~ 1.52	~~2.1~~ 1.87	~~2.5~~ 2.28	~~2.7~~ 2.62
2 Yr	0.426	0.681	0.856	~~1.3~~ 1.18	~~1.8~~ 1.48	~~2.0~~ 1.74	~~2.1~~ 1.85	~~2.6~~ 2.27	~~3.0~~ 2.75	~~3.2~~ 3.17
5 Yr	0.506	0.810	1.02	~~1.7~~ 1.46	~~2.2~~ 1.87	~~2.6~~ 2.20	~~2.7~~ 2.35	~~3.2~~ 2.87	~~3.7~~ 3.49	~~4.5~~ 4.07
10 Yr	0.565	0.904	1.14	~~2.0~~ 1.66	~~2.6~~ 2.16	~~3.0~~ 2.56	~~3.2~~ 2.75	~~3.7~~ 3.36	~~4.6~~ 4.12	~~5.2~~ 4.87
25 Yr	0.641	1.02	1.30	~~2.3~~ 1.92	~~3.0~~ 2.56	~~3.5~~ 3.08	~~3.8~~ 3.32	~~4.2~~ 4.08	~~5.1~~ 5.08	~~6.0~~ 6.09
50 Yr	0.698	1.11	1.41	~~2.6~~ 2.12	~~3.4~~ 2.87	~~4.0~~ 3.50	~~4.4~~ 3.79	~~5.1~~ 4.70	~~6.0~~ 5.92	~~7.0~~ 7.18
100 Yr	0.754	1.20	1.52	~~3.0~~ 2.32	~~4.0~~ 3.20	~~4.5~~ 3.95	~~4.9~~ 4.29	~~5.4~~ 5.37	~~6.3~~ 6.85	~~7.3~~ 8.41
Max Prob								27.0		

* Storm Volumes from NOAA Atlas 14 for the Vienna Tysons Corner Station (Station ID:44-8737) except for the maximum probable storm which is from NWS Hydrometeorological Report No. 51.

~~Average Relationship – 30 Minute Storm~~
~~5 Minutes – .37 of 30 Minutes~~
~~10 Minutes – .57 of 30 Minutes~~
~~15 Minutes – .72 of 30 Minutes~~

Amend §6-1600 (Design and Construction of Dams and Impoundments), subsection 6-1603 (Hydrologic Design Criteria for Dams Regulated by the County), by revising paragraph 6-1603.1A to read as follows:

6-1603.1A The SDF shall be determined based on a spillway design storm determined from Plates 46-6, ~~and~~ 47A-6, and 47B-6. The spillway design storm total rainfall amount shall also be determined from Plate 46-6. The minimum storm duration shall be 24-hour. A storm hyetograph shall be constructed using the ~~NRSC~~ NOAA_C, 24-hour duration, ~~Type II~~ rainfall distribution shown in Plates 47A-6, 47B6, and 48-6. Once the spillway design storm hyetograph is constructed, the SDF hydrograph shall be determined using standard NRCS unit hydrograph techniques.

Amend §6-1600 (Design and Construction of Dams and Impoundments), subsection 6-1603 (Hydrologic Design Criteria for Dams Regulated by the County), by revising paragraph 6-1603.2E to read as follows:

6-1603.2E The 10-, 25-, and 50-year recurrence interval floods mentioned in § 6-1603.2A thru § 6-1603.2D shall be developed as hydrographs using a minimum 24-hour storm duration, rainfall amounts from Table 6.19, storm distribution from Plates 47A-6 and 47B-6, and standard NRCS unit hydrograph techniques for converting the rainfall hyetograph to a runoff hydrograph.

Amend Chapter 6 (Storm Drainage) by deleting existing Plate No. 3-6 (Intensity Duration Frequency Curves) and replacing it with new Plate No. 3A-6 (Intensity Duration Frequency Curves) and Plate 3B-6 (Intensity Duration Frequency Values):

Amend Chapter 6 (Storm Drainage) by revising Plate No. 38-6 (Typical Rainfall Ponding Ring Section) as noted:

Amend Chapter 6 (Storm Drainage) by deleting plates 39-6 (Mass Diagram), 40-6 (Unit Inflow Hydrograph – 10-Year – 2-Hour Storm – 1 Impervious Acre), and 41-6 (Unit Hydrograph per Impervious Acre 100-Year Frequency Storm):

Amend Chapter 6 (Storm Drainage) by revising Plate No. 46-6 (24 Hour Design Storm Chart for Spillway Design Flood (SDF)) as noted:

Amend Chapter 6 (Storm Drainage) by deleting existing Plate No. 47-6 (County 100 Year, 24 Hour Rainfall Distribution) and replacing it with new Plate No. 47A-6 (24 Hour Rainfall Distribution) and Plate 47B-6 (24 Hour Rainfall Distribution):

Amend Chapter 6 (Storm Drainage) by deleting existing Plate No. 48-6 (100 Year, 24 Hour Rain Distribution (Hyetograph)) and replacing it with new Plate No. 48-6 (24 Hour Rainfall Distribution (Hyetograph)):

Amend Chapter 13 (PFM Structure, Interpretations, Definitions, Abbreviations, and Unit Conversion Tables) as follows:

Amend §13-0300 (Definitions and Abbreviations) by adding the following definition:

NOAA – National Oceanic and Atmospheric Administration

This amendment shall become effective on February 3, 2016 at 12:01 a.m.

GIVEN under my hand this 2nd day of February, 2016.

CATHERINE A. CHIANESE
Clerk to the Board of Supervisors