Stormwater Management Rule Stakeholder Meeting

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Rational Method

Q= CIA

where:

Q= peak flow in cubic feet per second (ft3/s)

C = runoff coefficient (weighted)

I = rainfall intensity in inches (in) per hour

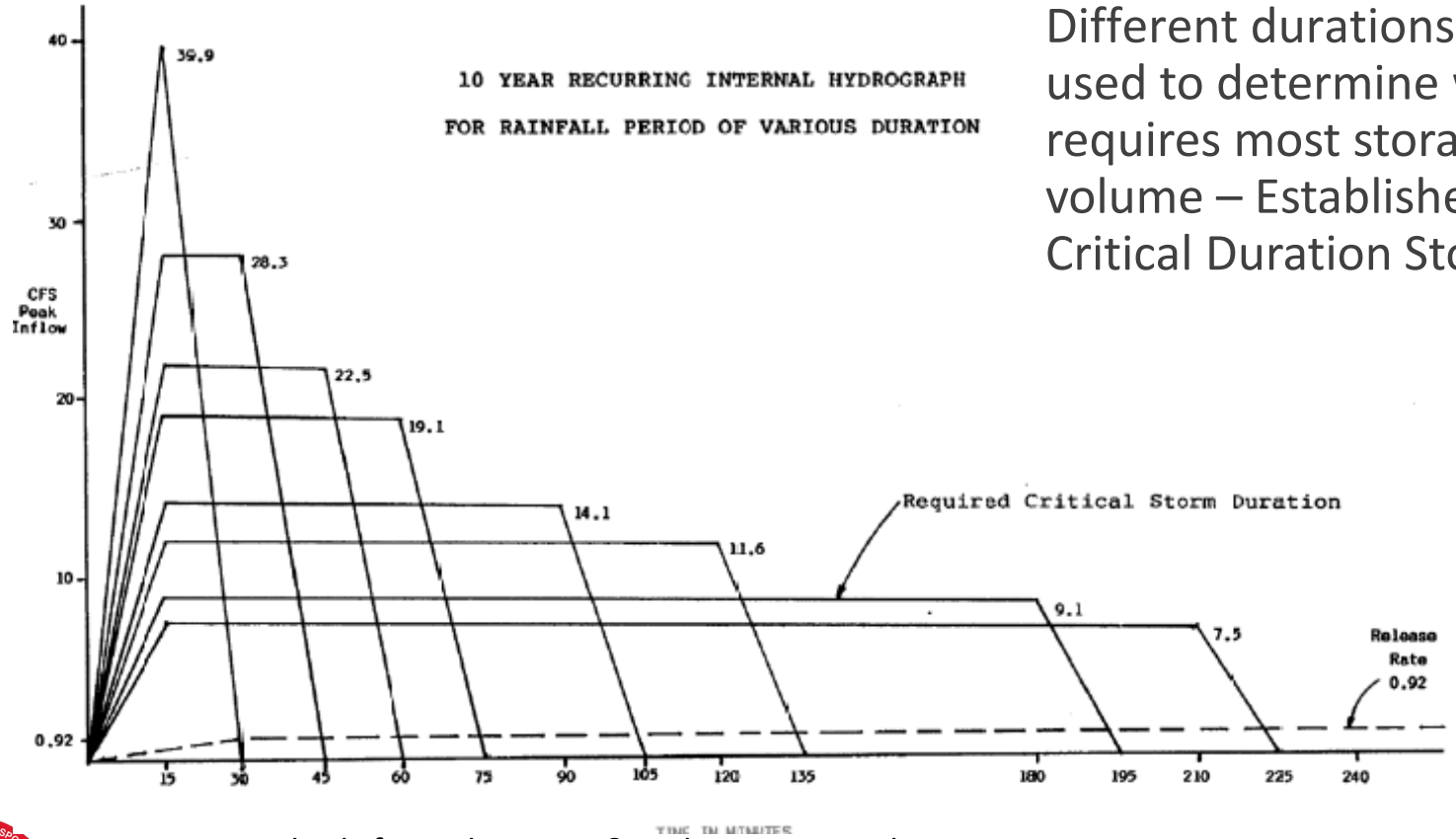
A = drainage area in acres

Table 10-4

Recommended Coefficient of Runoff Values for Various Selected Land Uses

Land Use	Description	Hydrologic Soils Group			
		A	B	C	D
Cultivated Land	without conservation treatment	0.49	0.67	0.81	0.88
	with conservation treatment	0.27	0.43	0.67	0.67
Pasture or Range Land	poor condition	0.38	0.63	0.78	0.84
Meadow	good condition	---	0.25	0.51	0.65
	good condition	---	---	0.41	0.61
Wood or Forest Land	thin stand, poor cover, no mulch	---	0.34	0.59	0.70
	good cover	---	---	0.45	0.59
Open Spaces, Lawns, Parks, Golf Courses, Cemeteries					
Good Condition	grass cover on 75% or more	---	0.25	0.51	0.65
Fair Condition	grass cover on 50% to 75%	---	0.45	0.63	0.74
Commercial and Business Area	85% impervious	0.84	0.90	0.93	0.96
Industrial Districts	72% impervious	0.67	0.81	0.88	0.92
Residential	average % impervious				
Average Lot Size (acres)					
1/8	65	0.59	0.76	0.86	0.90
1/4	38	0.29	0.55	0.70	0.80
1/3	30	---	0.49	0.67	0.78
1/2	25	---	0.45	0.65	0.76
1	20	---	0.41	0.63	0.74
Paved Areas	parking lots, roofs, driveways, etc.	0.99	0.99	0.99	0.99
Streets and Roads	paved with curbs & storm	0.99	0.99	0.99	0.99
	sewers	0.57	0.76	0.84	0.88
	gravel	0.49	0.69	0.80	0.84
	dirt				

Modified Rational Method



Different durations are used to determine which requires most storage volume – Establishes Critical Duration Storm

Source: Standards for Soil Erosion & Sediment Control in NJ

Modified Rational Method

Table A9.2

Storage-Duration Values

Duration of Storm (hr) (1)	Intensity I (in/hr) (2)	Peak Flow Q (cfs) (3)	Volume of Runoff (cuft) (4)	Release Flow Volume (cuft) (5)	Required Storage Volume (cuft) (6)	
0.25	4.8	39.9	35,925	828	35,097	
0.50	3.4	28.3	50,894	1,656	49,238	
0.75	2.7	22.5	60,624	2,484	58,140	
1.00	2.3	19.1	68,856	3,312	65,544	
1.50	1.7	14.1	76,341	4,968	71,373	
2.00	1.4	11.6	83,825	6,624	77,201	
3.00	1.1	9.1	98,794	9,936	88,858	<< Maximum Storage Volume Required
3.50	0.9	7.5	94,303	11,592	82,711	

Source: Standards for Soil Erosion & Sediment Control in NJ

Compare Rational Method Hydrograph to a TR-55 Hydrograph (Pre-Dev.)

Drainage Area = 10.0 Acres

T_C = 0.50 hours

Land Use = Meadow in Good Condition, HSG – C

Runoff Curve Number = 71 *(TR-55)*

Runoff Coefficient = 0.44 *(MRM)*

10 Year Storm

What is the difference between Runoff Volumes, Peak Flow Rates and Hydrograph Shape?

Source: P. Schiariti, Mercer SCD

Comparison between TR-55 and Rational Method Hydrographs (Pre-Dev.)

	Tr-55	Rational	Difference
Q_{PEAK}	14.03 cfs	14.08 cfs	Negligible
T_{PEAK}	12.38 Hrs.	0.50 Hrs.	Significant
Vol.	76,775 cf	38,020 cf	Significant

Source: P. Schiariti, Mercer SCD

Compare Modified Rational Method (MRM) Hydrograph to a TR-55 Hydrograph (Post-Dev.)

Drainage Area = 10.0 Acres

T_C = 0.20 hours

Land Use = Industrial, HSG – C

Runoff Curve Number = 91 *(TR-55)*

Runoff Coefficient = 0.88 *(MRM)*

10 Year Storm

Pre-Development $Q_{PEAK\ 10\ YEAR}$ = *14.03 cfs*

What is the difference between Runoff Volumes, Peak Flow Rates and Hydrograph Shape?

Source: P. Schiariti, Mercer SCD

Comparison between TR-55 and Rational Method Hydrographs (Post-Dev.)

	Tr-55	MRM	Difference
Q_{PEAK}	38.46 cfs	38.65 cfs	Negligible
T_{PEAK}	12.11 Hrs.	0.10 Hrs.	Significant
Vol.	144,474 cf	41,743 cf	Significant

Source: P. Schiariti, Mercer SCD

Summary & Recommendation

- Many people have difficulty using the Modified Rational method correctly – Critical Duration is not in most programs
- Modified Rational can have dramatic changes in inflow volume which is related to outflow peak
- Volume is very different than NRCS Method
- Rational Method is appropriate for comparison of peak flows
- For Peak flow comparison only, Rational Method can be used
- Where runoff hydrographs are necessary, NRCS runoff method should be used
- Rational and NRCS methods cannot be mixed

Addressing Volume to Basin

Development typically addresses the peak flow criteria for a site

Sometimes, downstream structures exist that are sensitive to runoff volume

Increased site runoff volume to another BMP which can change the function of the device

Sometimes, a large runoff volume is proposed to discharge to a much smaller basin

An analysis should be performed to ensure that upstream volume will not negatively impact the structure, even if the peak flows are met or reduced