Example 8.4

Estimate the runoff that would result from 3.7 inches (9.4 cm) of rain falling on a watershed characterized by a CN of 78.

Solution

$$S = \frac{1{,}000}{\text{CN}} - 10 = \frac{1{,}000}{78} - 10 = 2.82 \text{ in.}$$

$$Q \text{ or } V_R = \frac{(P - 0.2S)^2}{P + 0.8S} = \frac{(3.7 - 0.2(2.82))^2}{3.7 + 0.8(2.82)} = 1.7 \text{ in.}$$

$$S = \frac{2{,}540}{\text{CN}} - 25.4 = \frac{2{,}540}{78} - 25.4 = 7.16 \text{ cm}$$

$$V_R = \frac{(P - 0.2S)^2}{P + 0.8S} = \frac{(9.4 - 0.2(7.16))^2}{9.4 + 0.8(7.16)} = 4.2 \text{ cm}$$

Source: Wurbs & James, 2002

Example 8.5

A design storm was developed in Example 7.11. This storm occurs over a watershed characterized by a CN of 80. Estimate the runoff that results from each of the twelve 2-hour increments of rainfall.

Solution The design storm from Example 7.11 is reproduced in the first three columns of the following table. Given P in column 3, V_R is determined using Eqs. 8.15 and 8.16 and recorded in column 4. The P and V_R in Eqs. 8.15 and 8.16 are the cumulative total rainfall depth since the storm began and the corresponding runoff. The ΔV_R in column 5 represents the runoff from each 2-hour increment of rainfall and is computed as the difference between successive depths in column 4. The ΔV_R in column 5 are required for the unit hydrograph computations in Example 8.9.

$$S = \frac{2{,}540}{\text{CN}} - 25.4 = \frac{2{,}540}{80} - 25.4 = 6.35 \text{ cm}$$

(or) $S = \frac{1{,}000}{CN} - 10$ in inches

or Q

Eq. 8.15 $$V_R = \frac{(P - 0.2S)^2}{P + 0.8S} = \frac{(P - 0.2(6.35))^2}{P + 0.8(6.35)} = \frac{(P - 1.27)^2}{P + 5.08}$$

Eq. 8.16 $V_R = 0$ for $P \leq I_A = 0.2S$

Time (hr) (1)	Rainfall depth, ΔP (cm) (2)	Rainfall depth, P (cm) (3)	Runoff depth, V_R (cm) (4)	Incremental ΔV_R (cm) (5)
0		0.00	0.00	
2	0.48	0.48	0.00	0.00
4	0.58	1.06	0.00	0.00
6	0.72	1.78	0.04	0.04
8	0.95	2.73	0.27	0.24
10	1.57	4.30	0.98	0.70
12	12.13	16.43	10.68	9.70
14	2.46	18.89	12.96	2.27
16	1.18	20.07	14.06	1.10
18	0.82	20.89	14.82	0.76
20	0.63	21.52	15.42	0.60
22	0.53	22.05	15.92	0.50
24	0.45	22.50	16.35	0.43

Source: Wurbs & James, 2002