Example 7.1

Given an initial infiltration capacity f_0 of 2.9 in./hr and a time constant k of 0.28 hr^{-1}, derive an infiltration capacity versus time curve if the ultimate infiltration capacity is 0.50 in./hr. For the first 8 hours, estimate the total volume of water infiltrated in inches over the watershed.

Solution:

1. Using Horton's equation (Eq. 7.1), values of infiltration can be computed for various times. The equation is:

$$f = f_c + (f_0 - f_c)e^{-kt}$$

2. Substituting the appropriate values into the equation yields:

$$f = 0.50 + (2.9 - 0.50)e^{-0.28t}$$

3. For the times shown in Table 7.3, values of f are computed and entered into the table. Using a spreadsheet graphics package, the curve of Fig. 7.8 is derived.

TABLE 7.3 Calculations for Example 7.1

Time (hr)	Infiltration (in./hr)	Time (hr)	Infiltration (in./hr)
0	2.90	5.00	1.09
0.10	2.83	6.00	0.95
0.25	2.74	7.00	0.84
0.50	2.59	8.00	0.76
1.00	2.31	9.00	0.69
2.00	1.87	10.00	0.65
3.00	1.54	15.00	0.54
4.00	1.28	20.00	0.51

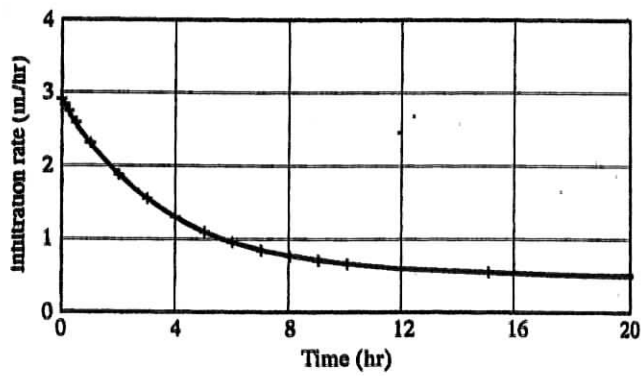

FIGURE 7.8
Infiltration curve for Example 7.1.

4. To find the volume of water infiltrated during the first 8 hours, Eq. 7.1 can be integrated over the range of 0–8:

$$V = \int [0.50 + (2.9 - 0.50)e^{-0.28t}]dt$$

$$V = [0.5t + (2.40 - 0.28)e^{-0.28t}]_0^8$$

$$V = 11.84 \text{ in.}$$

The volume over the watershed is thus 11.84 in.

SOURCE: Viessman, Jr. & G. L. Lewis
Introduction to Hydrology
Prentice-Hall, 2003