

Equations and constants you may (or may not) find useful:

$$f^* = K \left[\frac{\psi \Delta \theta}{F^*} + 1 \right]$$

$$t_p = \frac{K \psi \Delta \theta}{i(i - K)}$$

$$f^* = \phi$$

$$I_a = 0.2S$$

$$Q(t) = Q_0 K^{(t-t_0)}$$

$$t_l = 0.6t_c$$

$$q_p = \frac{483.4A}{t_p}$$

$$T = \frac{1}{p}$$

$$1 \text{ mi}^2 = 640 \text{ ac}$$

$$1 \text{ hr} = 3600 \text{ s}$$

$$F^*(t) = Kt + \psi \Delta \theta \ln \left[1 + \frac{F^*}{\psi \Delta \theta} \right]$$

$$t_0 = t_p - \frac{1}{K} \left[F_p - \psi \Delta \theta \ln \left(1 + \frac{F_p}{\psi \Delta \theta} \right) \right]$$

$$P_e = \frac{(P - I_a)^2}{P - I_a + S}$$

$$S = \frac{1000}{CN} - 10$$

$$V_d = Ar_d$$

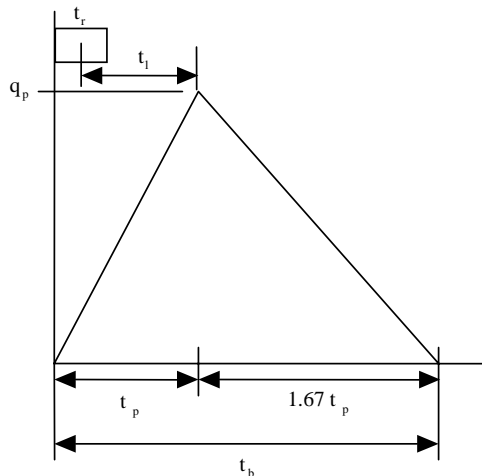
$$t_p = \frac{t_r}{2} + t_l$$

$$R_{k+1} = \alpha R_k + \frac{(1 + \alpha)}{2} (Q_{k+1} - Q_k)$$

$$1 \text{ ft} = 12 \text{ in}$$

$$1 \text{ acre} = 43560 \text{ ft}^2$$

$$1 \text{ day} = 86400 \text{ s}$$



(25) 1. Miscellaneous

The Dirty Creek watershed has the following watershed characteristics:

Area (mi ²)	Hydrologic Soil Group	Cover type
6.0	A	Open Space (Good condition)
3.5	B	Residential districts (1/2 acre lots)
0.5	B	Impervious areas (paved; open ditches)

Time of concentration (t_c): 20 hours

Use the Soil Conservation Service (SCS) methods to answer the (a) and (b):

- a) The composite runoff curve number (CN) for Antecedent Moisture Condition II is _____.
If a storm produces 1 inch of rainfall in 30 minutes, the rainfall excess is _____.
- b) The time base (t_b) of the 4-hour unit hydrograph is _____ hours. If this 4-hour unit hydrograph is used for streamflow prediction for a storm an effective duration of 12-hours, the time base (t_b) of the direct runoff hydrograph is _____ hours.
- c) A 40-year return period discharge would inundate a new temporary storage structure. The temporary structure will be used for a 5-year period. The probability that the structure will not be inundated is any given year is _____. The risk of flooding during the 5-year design life is _____.
- d) You are given a streamflow hydrograph for a flood event. Provide a step-by-step explanation on how to do baseflow separation using the straight-line method B:

(25) 2. Green-Ampt Infiltration Equations

A constant intensity rainstorm produces 16 mm of rainfall in 2 hours on a loam soil:

Green-Ampt Parameters: (Loam Soil)

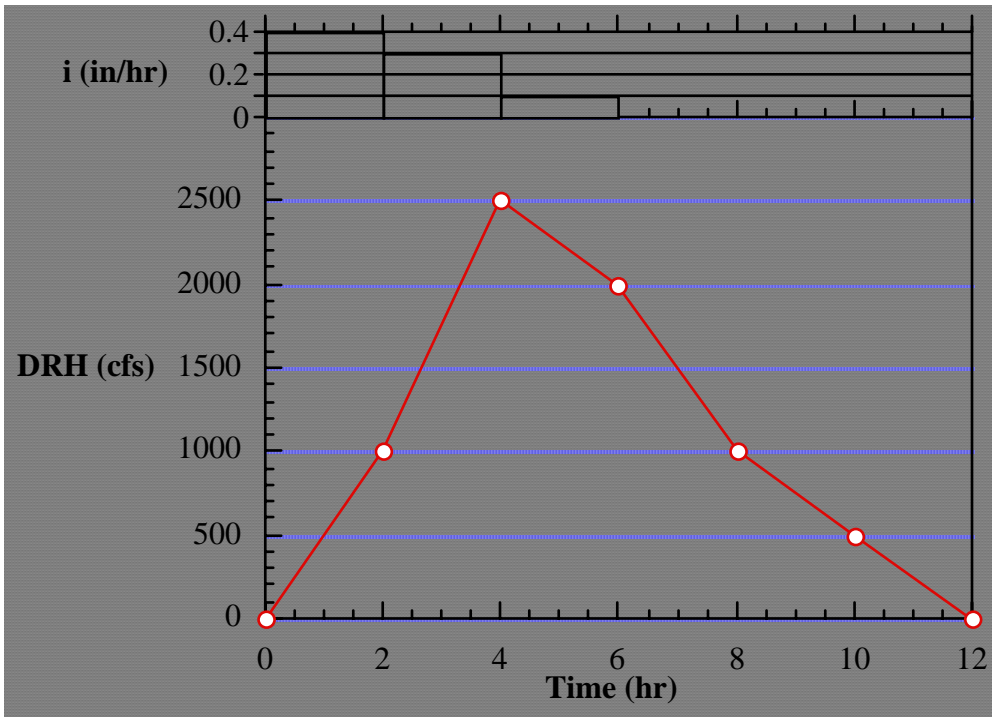
- Initial moisture content θ_i is 0.15
- Hydraulic conductivity K is 1 mm/hr
- Soil suction head ψ is 200 mm
- Soil porosity η is 0.55
- The equivalent time origin t_0 for this storm is 0.683 hours

Compute the following for two different times during the storm.

- a) The cumulative infiltration (F) at $t=1$ hours is [7.3 | 8.0 | 8.6 | 13.3] (circle one) mm. In the space below, do the calculations required to justify your selection. Guesses without supporting calculations receive NO CREDIT.
- b) The infiltration rate (f) at $t=1$ hours is _____ mm/hr.
- c) The cumulative infiltration (F) at $t=2$ hours is [9.9 | 10.0 | 15.4 | 19.2] (circle one) mm. In the space below, do the calculations required to justify your selection. Guesses without supporting calculations receive NO CREDIT.
- d) The infiltration rate (f) at $t=2$ hours is _____ mm/hr.

(25) 3. Unit Hydrograph Derivation

A storm produces a flood on a 30 mi² watershed. The areal-average rainfall intensity (i) and the direct runoff hydrograph for the event are shown below.



Use this information to estimate the following:

- The volume of direct runoff (V_d) is _____ acre-feet.
- The ϕ -index is _____ in/hr.
- The runoff coefficient (C) is _____ .
- The peak discharge is _____ cfs for the _____-hour unit hydrograph derived using this event (by the single event method).

(25) 4. Streamflow Prediction

An extreme rainstorm has occurred at the Dry Creek watershed. The intensity of rainfall excess (i_e) is shown below. Also shown is the 1-hour unit hydrograph for Dry Creek. Assume the baseflow in the creek at the time of the storm is a constant 15 cfs.

Time (hours)	i_e (in/hr)	Time (hours)	1-hour UH (cfs)
0		0	0
	1.0	1	80
2		2	120
	1.5	3	60
4		4	20
		5	0

Use this information to determine the following.

- a) The watershed area is _____ mi^2 .
- b) The direct runoff hydrograph (in cfs). *MARK YOUR ANSWER BELOW*
- c) The peak discharge of the streamflow hydrograph is _____ cfs at time _____ hour.

