CE 374 K – Hydrology

Second Quiz Review

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Infiltration

$$Q = -KA\frac{\Delta h}{L}$$

- Porous media flow
  - Terminology
    - Zones of saturation, aquifer types, aquifer properties, capillarity
  - Darcy's law
- Infiltration
  - Rate and cumulative infiltration
  - Models
    - Horton, Phillips, Green-Ampt
  - Time of ponding

$$f(t) = \frac{dF(t)}{dt}$$

$$F(t) = \int_0^t f(\tau)d\tau$$

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

$$f(t) = \frac{1}{2}S\sqrt{t} + Kt$$

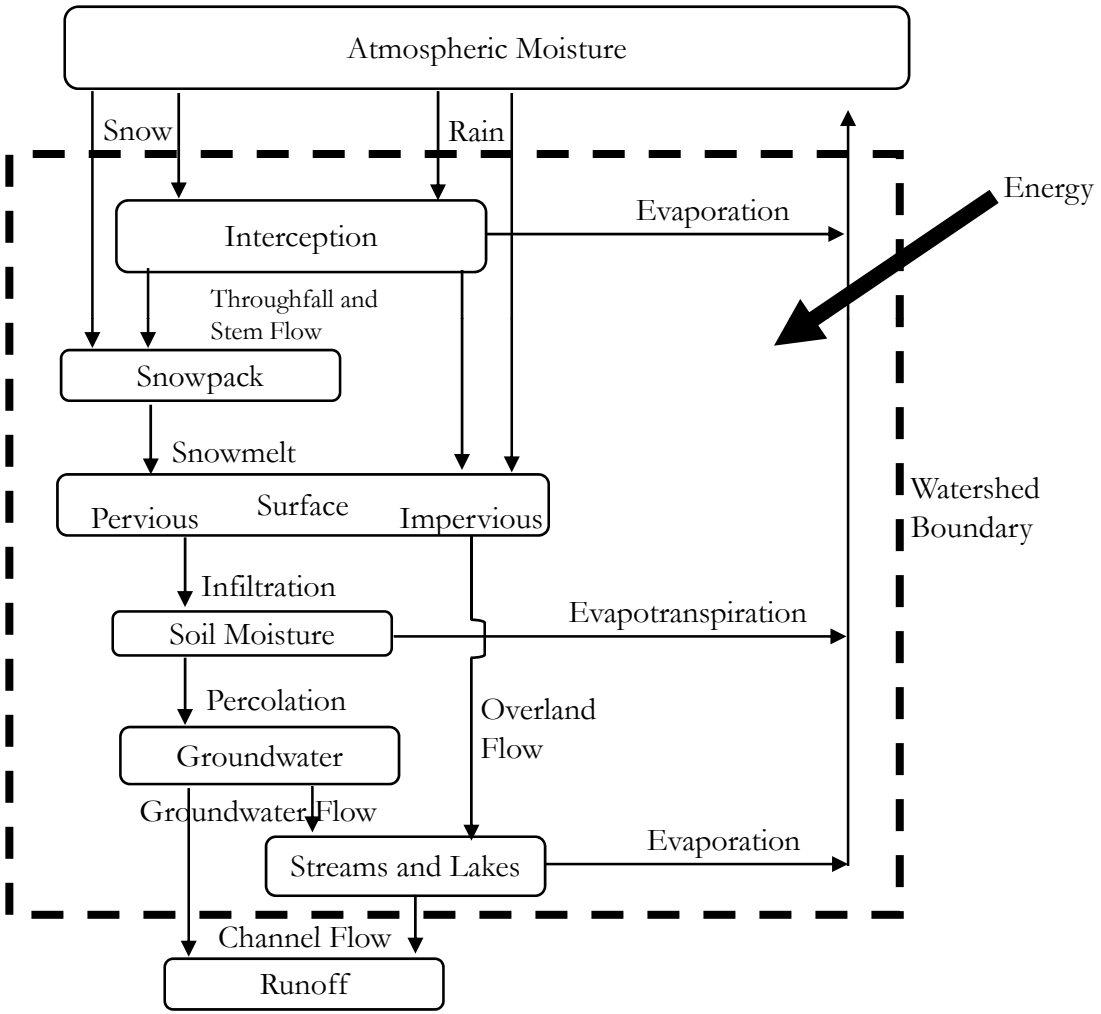
$$f = K\left(\frac{\Delta\theta\psi_f}{F} + 1\right)$$

$$F = Kt + \Delta\theta\psi_f \ln\left(1 + \frac{F}{\Delta\theta\psi_f}\right)$$

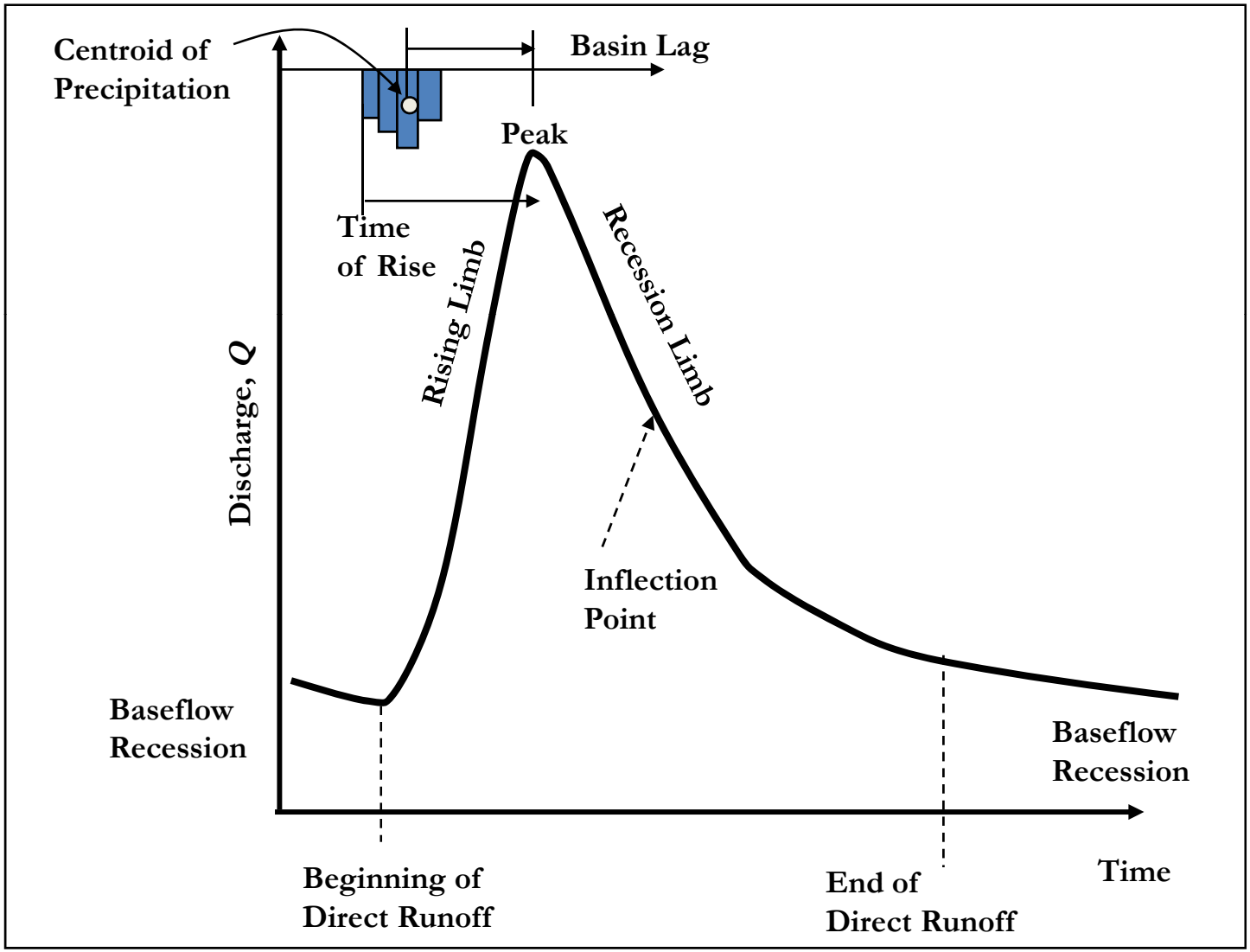
$$t_p = K\frac{\Delta\theta\psi_f}{i(i-K)}$$

Runoff Processes

- Watershed
  - Terminology
  - Concepts
- Streamflow
  - Components of hydrologic cycle affecting it

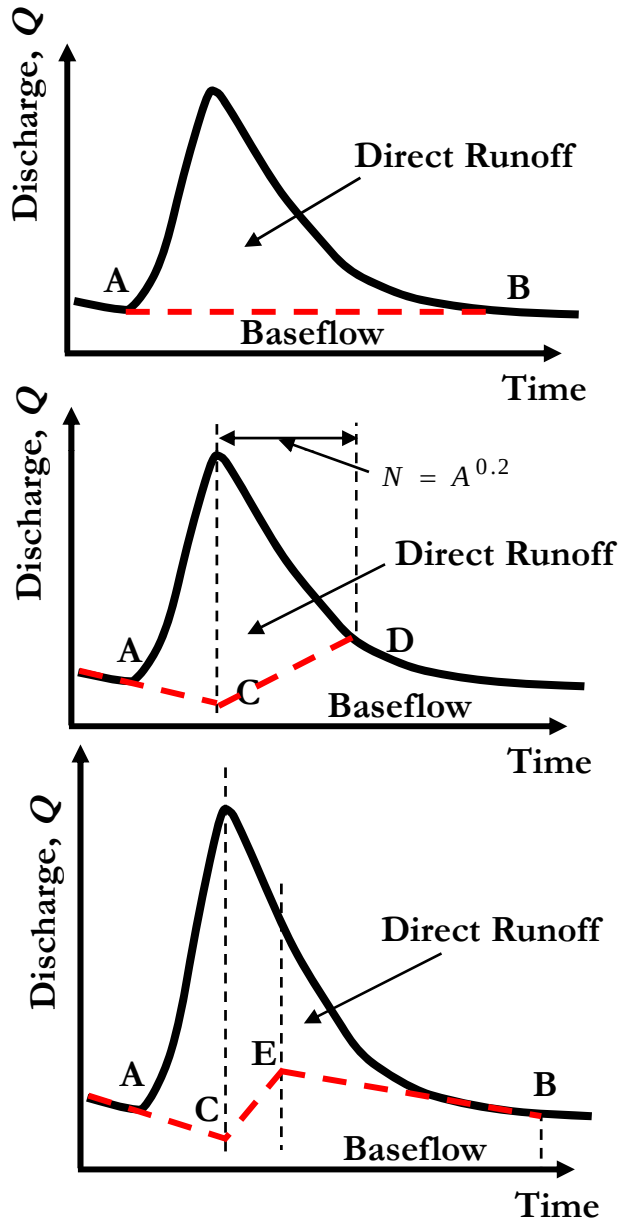


Hydrographs



Baseflow Separation

- Three techniques
  - Straight – line method
  - Fixed Base Method
  - Variable Slope Method



Abstraction (Losses) Estimation

- Phi – Index Method

$$r_d = \sum_{m=1}^{M} \left(R_m - \phi \Delta t \right)$$

$$r_d = \frac{V_d}{A} = \frac{\Delta t \sum_{n=1}^{N} Q_n}{A}$$

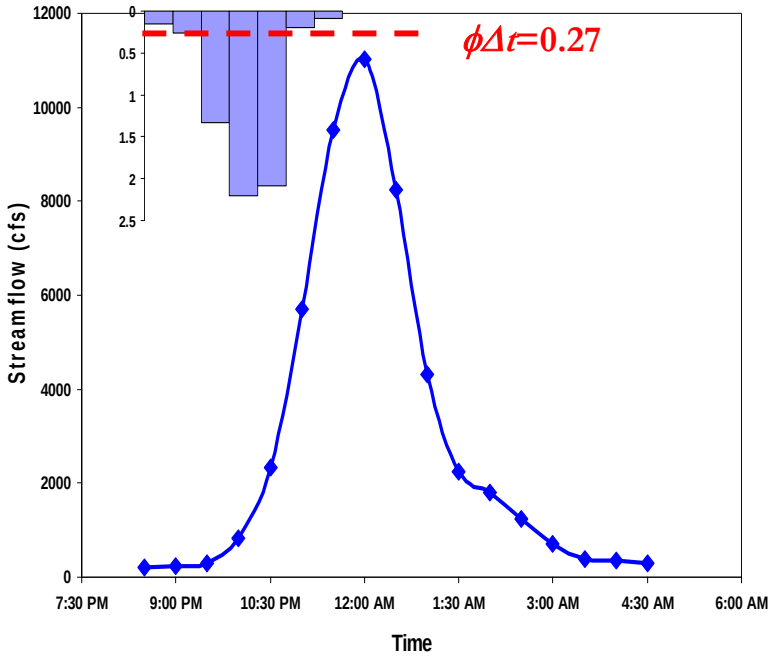
r_d = depth of direct runoff

R_m = observed rainfall

ϕ = Phi index

M = # intervals of rainfall contributing to driect runoff

Δt = time interval



Abstraction (Losses) Estimation

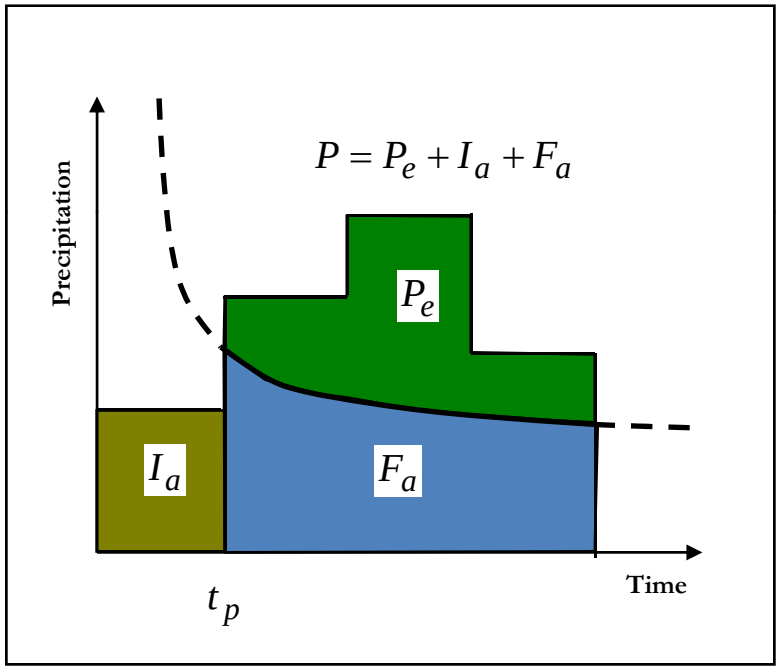
- SCS Curve Number Method

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

$$P_e = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$I_a = 0.2S$$

$$F_a = \frac{S(P - I_a)}{(P - I_a + S)}$$



P = Total Rainfall

P_e = Rainfall Excess

I_a = Initial Abstraction

F_a = Continuing Abstraction

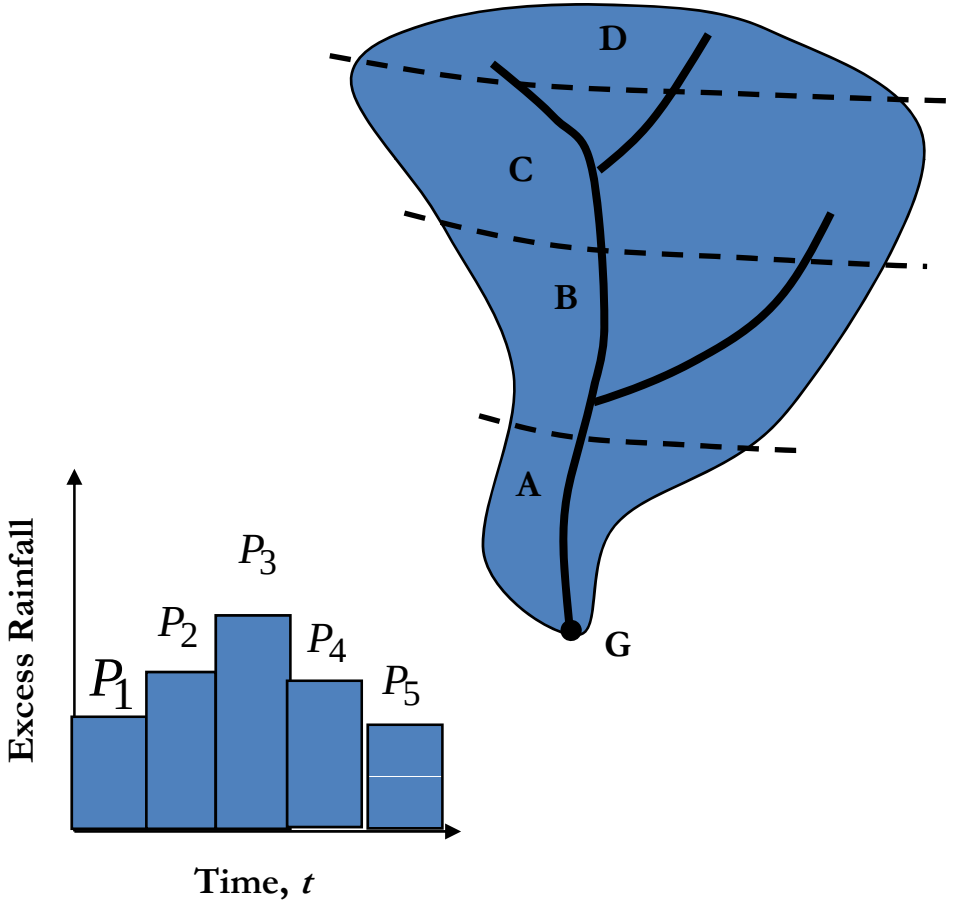
S = Potential Maximum Storage

Hydrologic Measurement

- Climate
- Precipitation
- Surface Water
  - Flow
  - Stage
  - Rating Curve

Unit Hydrograph

- Time – Area Relationship



$$Q_1 = P_1 A$$
$$Q_2 = P_2 A + P_1 B$$
$$Q_3 = P_3 A + P_2 B + P_1 C$$
$$Q_4 = P_4 A + P_3 B + P_2 C + P_1 D$$
$$Q_5 = P_5 A + P_4 B + P_3 C + P_2 D$$
$$Q_6 = 0 * A + P_5 B + P_4 C + P_3 D$$
$$Q_7 = 0 * A + 0 * B + P_5 C + P_4 D$$
$$Q_8 = 0 * A + 0 * B + 0 * C + P_5 D$$

Unit Hydrograph

- Derivation

$$Q_n = \sum_{m=1}^{n} P_m U_{n-m+1}$$

$$Q_1 = P_1 U_1$$
$$Q_2 = P_2 U_1 + P_1 U_2$$
$$Q_3 = P_3 U_1 + P_2 U_2 + P_1 U_3$$
$$Q_4 = P_3 U_2 + P_2 U_3 + P_1 U_4$$
$$Q_5 = P_3 U_3 + P_2 U_4 + P_1 U_5$$
$$Q_6 = P_3 U_4 + P_2 U_5 + P_1 U_6$$
$$Q_7 = P_3 U_5 + P_2 U_6 + P_1 U_7$$
$$Q_8 = P_3 U_6 + P_2 U_7 + P_1 U_8$$
$$Q_9 = P_3 U_7 + P_2 U_8 + P_1 U_9$$