CHAPTER 6

STORAGE FACILITIES

6.6 Preliminary Detention Calculations

6.6.1 Storage Volume

For small drainage areas, a preliminary estimate of the storage volume required for peak flow attenuation may be obtained from a simplified design procedure that replaces the actual inflow and outflow hydrographs with the standard triangular shapes shown in Figure 6.6.1-1 shown below.

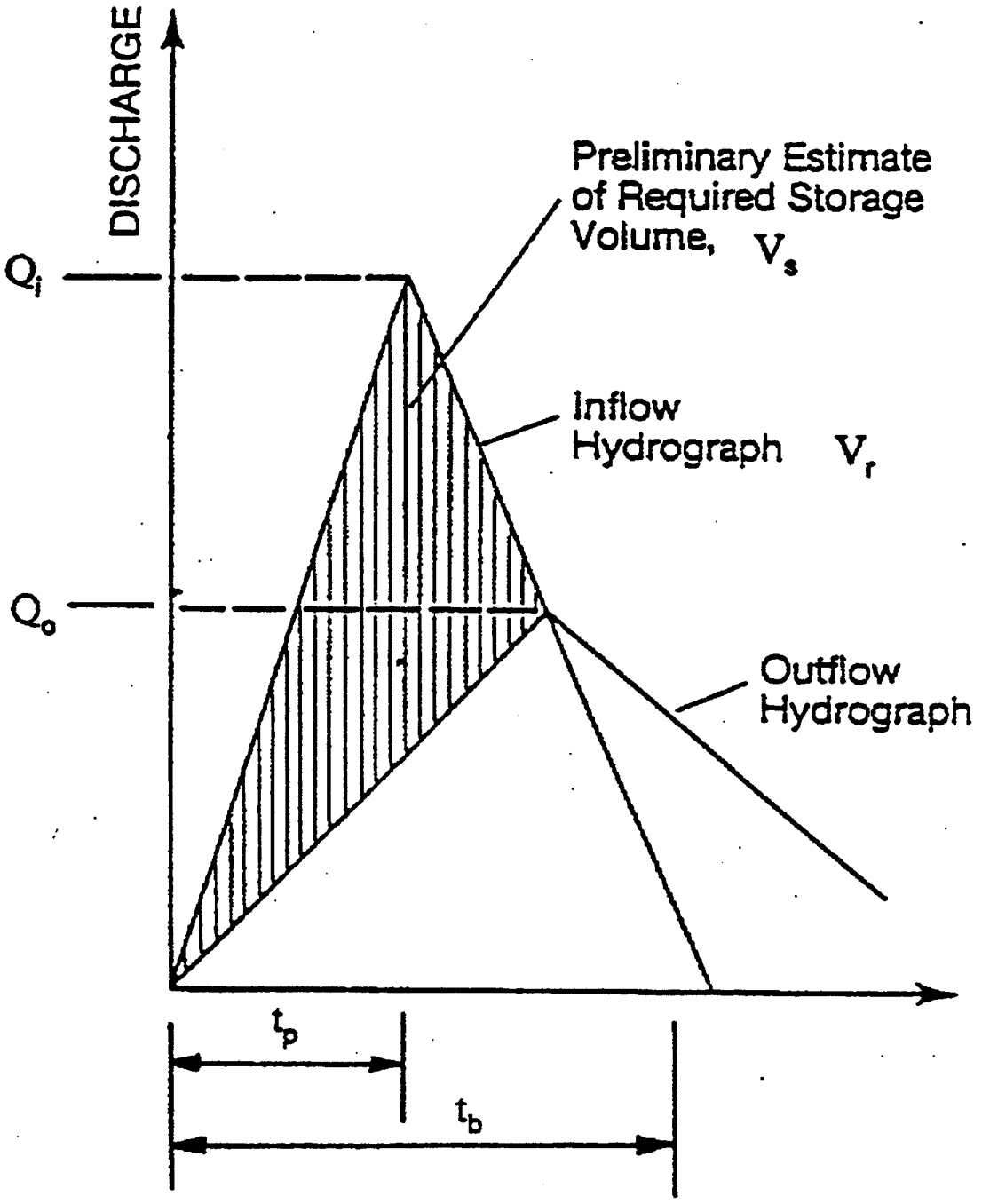
The required storage volume may be estimated from the area above the outflow hydrograph and inside the inflow hydrograph, expressed as:

$$V_s = 0.5 T_i (Q_i - Q_O) \qquad \textbf{(EQ-6.6.1-1)}$$

Where: V_s = storage volume estimate, ft^3
Q_i = peak inflow rate, cfs
Q_O = peak outflow rate, cfs
T_i = duration of basin inflow, sec

Any consistent units may be used for Equation EQ-6.6.1-1.

Figure 6.6.1-1
Triangular Shaped Hydrographs
(For Preliminary Estimate of Required Storage Volume)



6.6.2 Alternative Method

An alternative preliminary estimate of the storage volume required for a specified peak flow reduction can be obtained by the following regression equation procedure (Wycoff & Singh, 1986).

1. Determine input data, including the allowable peak outflow rate, Q_O, the peak flow rate of the inflow hydrograph, Q_i, the time base of the inflow hydrograph, t_b, and the time to peak of the inflow hydrograph, t_p.

2. Calculate a preliminary estimate of the ratio V_s/V_r using the input data from Step 1 and the following equation:

$$V_s / V_r = [1.291(1 - Q_O / Q_i)^{0.753}] / [(t_b / t_p)^{0.411}] \quad \textbf{(EQ-6.6.2-1)}$$

Where: V_s = volume of storage, in
V_r = volume of runoff, in
Q_O = outflow peak flow, cfs
Q_i = inflow peak flow, cfs
t_b = time base of the inflow hydrograph, hr (Determined as the time from the beginning of rise to a point on the recession limb where the flow is 5 percent of the peak.)
t_p = time to peak of the inflow hydrograph, hr

3. Multiply the volume of runoff, V_r, times the ratio V_s/V_r, calculated in Step 2 to obtain the estimated storage volume V_s.

6.6.3 Peak Flow Reduction

A preliminary estimate of the potential peak flow reduction for a selected storage volume can be obtained by the following procedure.

1. Determine volume of runoff, V_r, peak flow rate of the inflow hydrograph, Q_i, time base of the inflow hydrograph, t_b, time to peak of the inflow hydrograph, t_p, and storage volume, V_s.

2. Calculate a preliminary estimate of the potential peak flow reduction for the selected storage volume using the following equation (Singh, 1976):

$$Q_O / Q_i = 1 - 0.712(V_s / V_r)^{1.328} (t_b / t_p)^{0.546} \quad \textbf{(EQ-6.6.3-1)}$$

Where: Q_O = outflow peak flow, cfs
Q_i = inflow peak flow, cfs
V_s = volume of storage, in
V_r = volume of runoff, in
t_b = time base of the inflow, hydrograph, hr (Determined as the time from the beginning of rise to a point on the recession limb

where the flow is 5 percent of the peak.)

t_p = time to peak of the inflow hydrograph, in hours

3. Multiply the peak flow rate of the inflow hydrograph, Q_i, times the potential peak flow reduction calculated from step 2 to obtain the estimated peak outflow rate, $Q_{O,}$ for the selected storage volume (see example 6.8.3).

END OF SECTION 6.6