

Appendix

**D.11**

**Method for Computing the Channel Protection  
Storage Volume ( $Cp_v$ )**

The following procedure shall be used to design the channel protection storage volume (Cp<sub>v</sub>). The method is based on the Design Procedures for Stormwater Management Extended Detention Structures (MDE, 1987) and utilizes the NRCS, TR-55 Graphical Peak Discharge Method (USDA, 1986).

- ▶ Compute the time of concentration ( $t_c$ ) and the one-year post-development runoff depth ( $Q_a$ ) in inches.
- ▶ Compute the initial abstraction ( $I_a$ ) [ $I_a = 200/CN - 2$ ] and the ratio  $I_a/P$  where  $P$  is the one-year rainfall depth (see Table 2-2).
- ▶ With  $t_c$  and  $I_a/P$ , find the unit peak factor ( $q_u$ ) from Figure D.11.1 and compute the one year post-development peak discharge  $q_i = q_u A Q_a$  where  $A$  is the drainage in square miles.
- ▶ If  $q_i \leq 2.0$  cfs, Cp<sub>v</sub> is not required. Provide for water quality (WQ<sub>v</sub>) and groundwater recharge (Re<sub>v</sub>) as necessary.
- ▶ With  $q_u$ , find the ratio of outflow to inflow ( $q_o/q_i$ ) for  $T = 24$  hours from Figure D.11.2 (use  $T = 12$  hours in USE III/IV waters).

- ▶ Compute the peak outflow discharge  $q_o = q_o/q_i \times q_i$
- ▶ With  $q_o/q_i$ , compute the ratio of storage to runoff volume ( $V_s/V_r$ ).

$$V_s/V_r = 0.683 - 1.43(q_o/q_i) + 1.64(q_o/q_i)^2 - 0.804(q_o/q_i)^3$$

- ▶ Compute the extended detention storage volume  $V_s = (V_s/V_r) \times V_r$  (note:  $V_r = Q_a$ );

Convert  $V_s$  to acre-feet by  $\frac{V_s}{12} \times A$ , where  $V_s$  is in inches and  $A$  is in acres.

- ▶ Compute the required orifice area ( $A_o$ ) for extended detention design:

$$A_o = \frac{q_o}{C\sqrt{2gh_o}} = \frac{q_o}{4.81\sqrt{h_o}}$$

where  $h_o$  is the maximum storage depth associated with  $V_s$ .

- ▶ Determine the required maximum orifice diameter ( $d_o$ )  $d_o = \sqrt{4A_o/\pi}$ .

A  $d_o$  of less than 3.0” is subject to local jurisdictional approval, and is not recommended unless an internal control for orifice protection is used (App. D.8).

**Figure D.11.1** SCS Graphical Method of Determining Peak Discharge ( $q_u$ ) in csm/in for 24-Hour Type II Storm Distribution

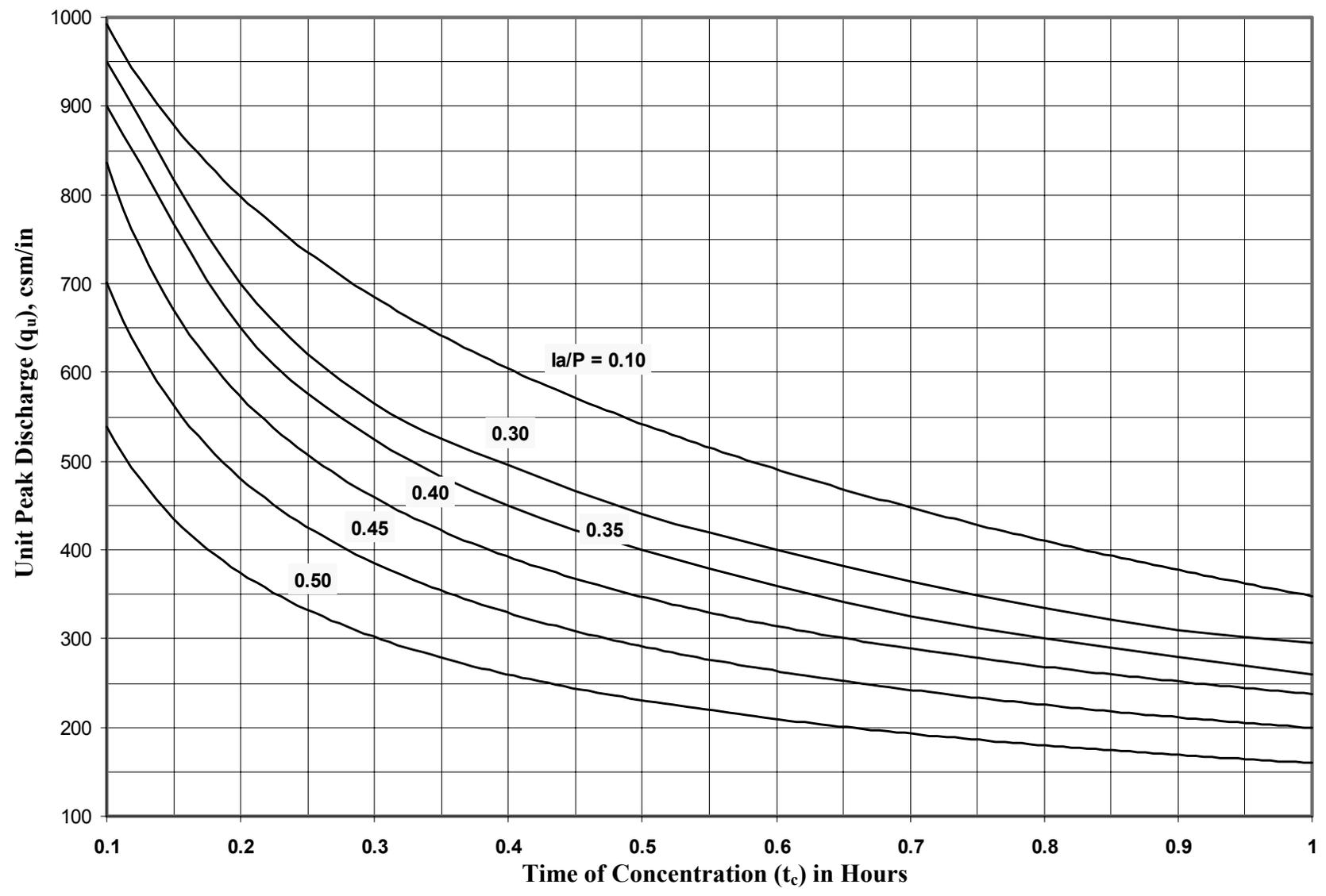
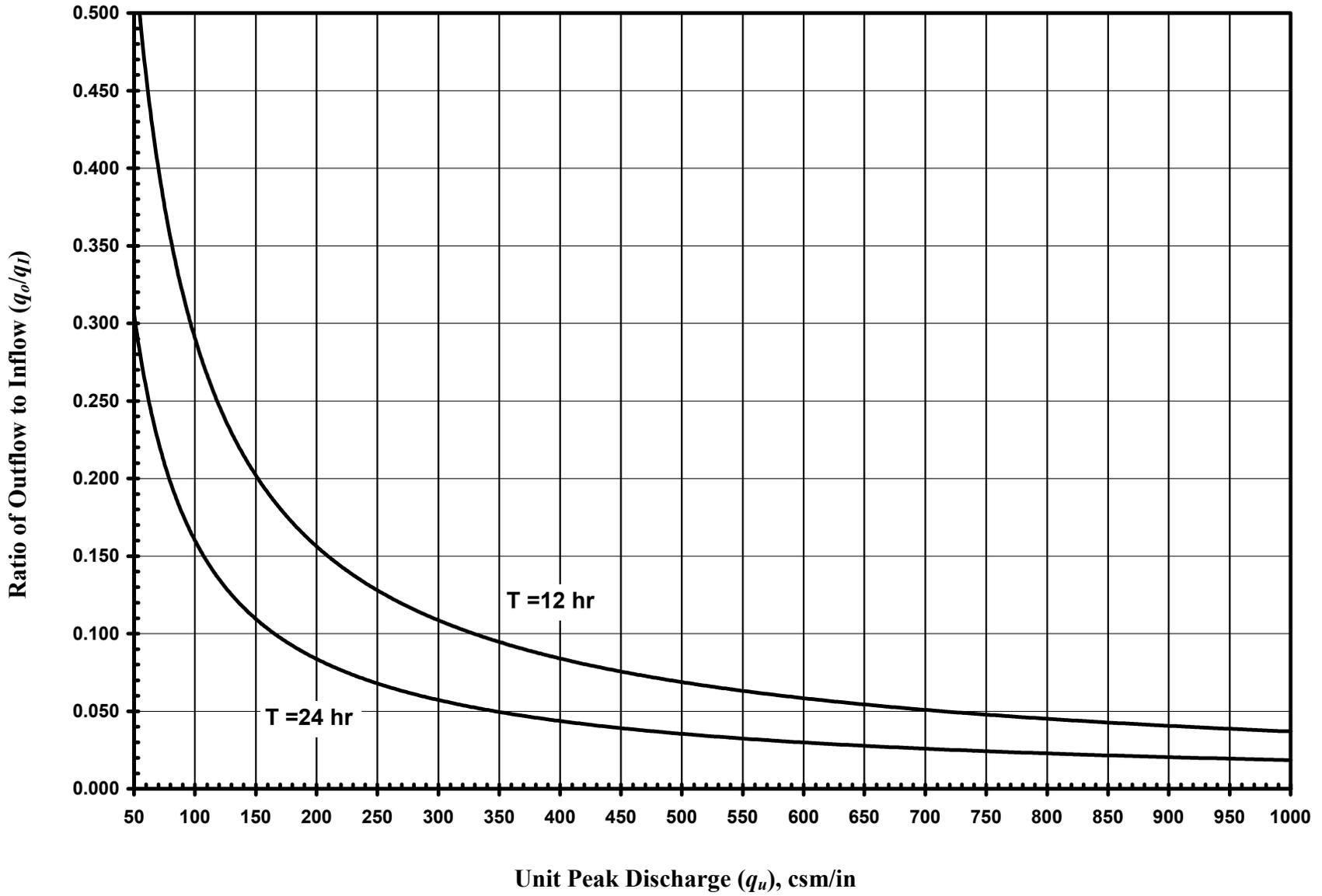


Figure D.11.2 Detention Time Versus Discharge Ratios ( $q_o/q_i$ )



D.11.3