The objective of this homework is become familiar with the Manning’s Equation to calculate flow rates in streams and the use of the Rational Method to calculate peak flow rates.

1. **Given:**

   ![Channel Diagram](image)

   Required:
   
   1. Read pages 108 – 110 in the Haan et al. textbook (or other text on hydrology) on the Manning’s Equation.
   2. Calculate the flow in cfs for the channel section shown above. The channel slope is 0.05%.

2. **Given:**

   You are a consultant for a land development firm. A large orchard is planned for installation in the watershed shown in Figure 1. This watershed is very close to Stillwater, OK. Therefore you can use the intensity-duration-frequency (IDF) curves for Stillwater, OK (see below). Your job is to determine the pre-development peak flow rate \( q_p \) for the watershed using the Rational Method for a 5-yr design storm.

**Note:** Figure 1 will be given out in class.
Figure 3.4 Smoothed intensity–duration–frequency curves, Stillwater, Oklahoma, based on Eq. (3.4) with $K = 1.75$, $x = 0.21$, $b = 0.12$, and $n = 0.80$. 
Table 3.24: Runoff coefficients for the Rational Equation (from the Haan et al.).

Required:

1. Read pages 76 and 83 – 85 in the Haan et al. textbook (or other text on hydrology) about the Rational Method.

2. Find the area of the watershed in acres.

3. Find the area weighted runoff coefficient (C). Show all calculations.

4. Find the time of concentration \((t_c)\) using equation 3.51 from the Haan et al. text (see below).

5. Find the rainfall intensity \((i)\) for the 5-yr storm with a duration of \(t_c\) near Stillwater, OK.

6. Determine the peak flow rate \((q_p)\) using the Rational Method.
\[ t_c = 0.0078L^{0.77}(L/H)^{0.385} \]  \hspace{1cm} (3.51, Haan et al. text)

**Where:**

- \( t_c \) = time of concentration in minutes
- \( L \) = maximum length of flow in feet
- \( H \) = elevation difference between the watershed outlet and the hydraulically most remote point in feet