Lesson 26: Hydrologic Response
Time of Concentration

F. Design example

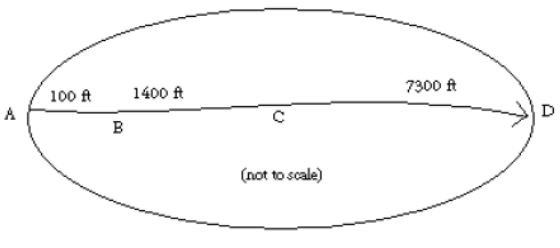
Time of concentration

Example: The sketch below shows a watershed. The problem is to compute T_c at the outlet of the watershed (point D). The 2-year 24-hour rainfall depth is 3.6 inches. All three types of flow occur from the hydraulically most distant point (A) to the point of interest (D). To compute T_c, first determine T_t for each segment from the following information:

Segment AB: Sheet flow
Dense grass
Slope (s) = 0.01 ft/ft
Length (L) = 100 ft

Segment BC: Shallow concentrated flow
Unpaved
s = 0.01 ft/ft
L = 1400 ft

Segment CD: Channel flow
Manning's n = .05
Flow area (a) = 27 ft^2
Wetted perimeter (p_w) = 28.2 ft
s = 0.005 ft/ft
L = 7300 ft



Worksheet 2: Time of Concentration (T_c) or Travel Time (T_t)

Project *Example* By _____ Date _____

Location _____ Checked _____ Date _____

Circle one: Present (Developed)

Circle one: (T_c) T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

	Sheet flow (Applicable to T_c only)	Segment ID	AB					
1.	Surface description (Table 2)……		Dense Grass					
2.	Manning's roughness coeff., n (Table 2)……..		0.24					
3.	Flow Length, L (Total L less than or equal to 300')…	ft	100					
4.	Two-year 24-hour rainfall, P_2……	in	3.6					
5.	Land slope, s……	ft / ft	0.01					
6.	$T_t = \frac{0.007(nL)^{0.8}}{(\sqrt{P_2})(s^{0.4})}$ Compute T_t……..	hr	0.30	+		=	0.30	
	Shallow concentrated flow	Segment ID	BC					
7.	Surface description (paved or unpaved)……..		Unpaved					
8.	Flow length, L……	ft	1400					
9.	Watercourse slope, s……..	ft / ft	0.01					
10.	Average velocity, V (Figure 1)……	ft / s	1.6					
11.	$T_t = \frac{L}{3600V}$ Compute T_t……..	hr	0.24	+		=	0.24	
	Open channel flow	Segment ID	CD					
12.	Cross sectional flow area, a……..	ft^2	27					
13.	Wetted perimeter, P_w……..	ft	28.2					
14.	Hydraulic radius, $r = \frac{a}{P_w}$ Compute r……	ft	0.957					
15.	Channel slope, s……..	ft / ft	0.005					
16.	Manning's roughness coeff., n……..		0.05					
17.	$V = \frac{1.49r^{2/3}s^{1/2}}{n}$ Compute V……..	ft / s	2.05					
18.	Flow length, L……	ft	7300					
19.	$T_t = \frac{L}{3600V}$ Compute T_t……..	hr	0.99	+		=	0.99	
20.	Watershed or subarea T_c or T_t (add T_t in steps 6, 11 and 19)……						hr	1.53