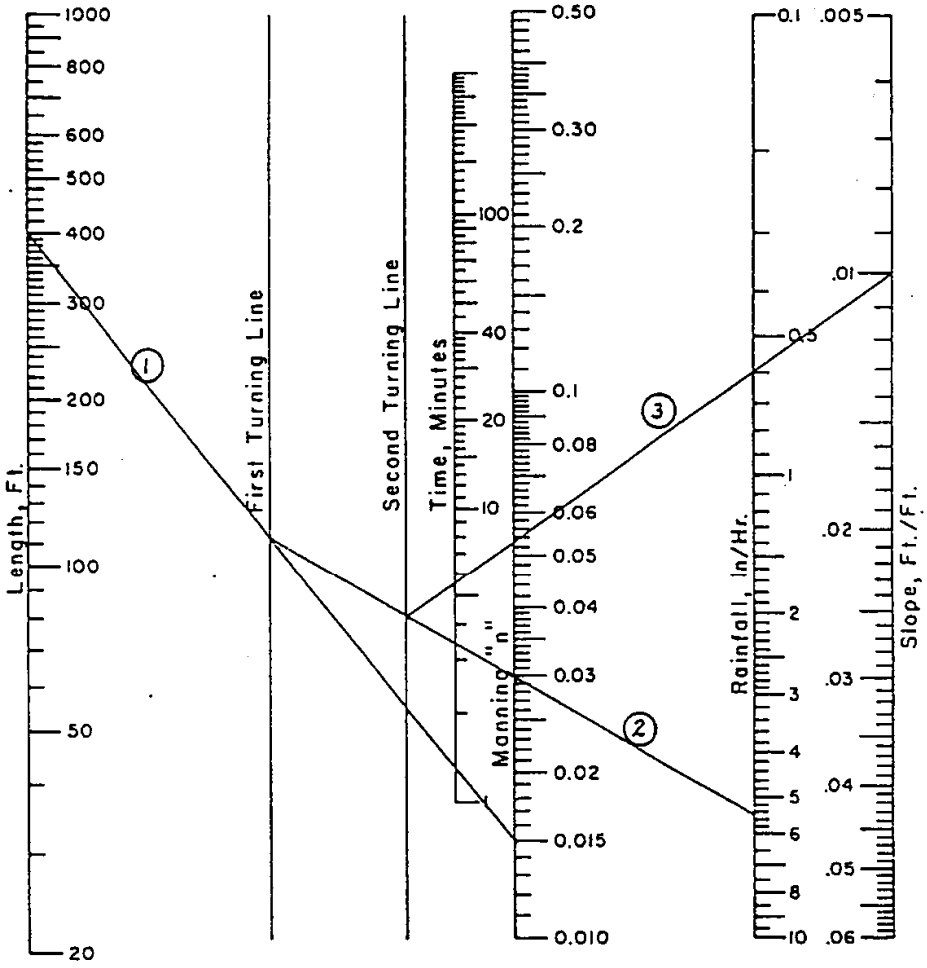
Appendix 6D-2 Kinematic Wave Formulation Overland Flow

Equation solved by nomograph: $t_c\ (min) = .93 \frac{L^{0.6} n^{0.6}}{i^{0.4} S_o^{0.3}}$



The initially assumed value of i and the nomograph value of t must be checked against the applicable intensity-duration-frequency curve by trial and error.

Example:
L = 400 ft.
n = 0.015
i = 5.5 in./hr.
S_o = 0.01
t = 5.5 min.

ONE INCH is 25.4mm
ONE FOOT is 0.3048m

Nomograph for determining time of concentration for overland flow, Kinematic Wave Formulation. *(After Ragan.)*

Comments:
VDOT has determined that the Kinematic Wave Method should only be used for:
a) Impervious Surfaces
b) n = 0.05 or less
c) Length = 300' Maximum
d) See page 2 of 2 for suggested Manning's roughness coefficients

Appendix 6D-2 Mannings Roughness Coefficient for Shallow Sheet Flow

Surface Description	n[1]
Smooth surfaces - concrete, asphalt, gravel, or bare soil (compacted)	0.011
Fallow – no residue (non-compacted bare, plowed soil)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grasses:	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermuda grass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

Soil Conservation Service Urban Hydrology for small water sheds Technical Release No. 55, Natural Resources Conservation Service, Washington, D.C. 1986

[1] The n values are a composite of information complied by Engman (1986).
[2] Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass and native grass mixtures.
[3] When selecting n, consider cover to a height of about 1 inch. This is the only part of the plant cover that will obstruct sheet flow.

Source: AASHTO 2005 MODEL DRAINAGE MANUAL (text shown in parentheses are VDOT additions to the original chart which were included to simplify interpretation and application)