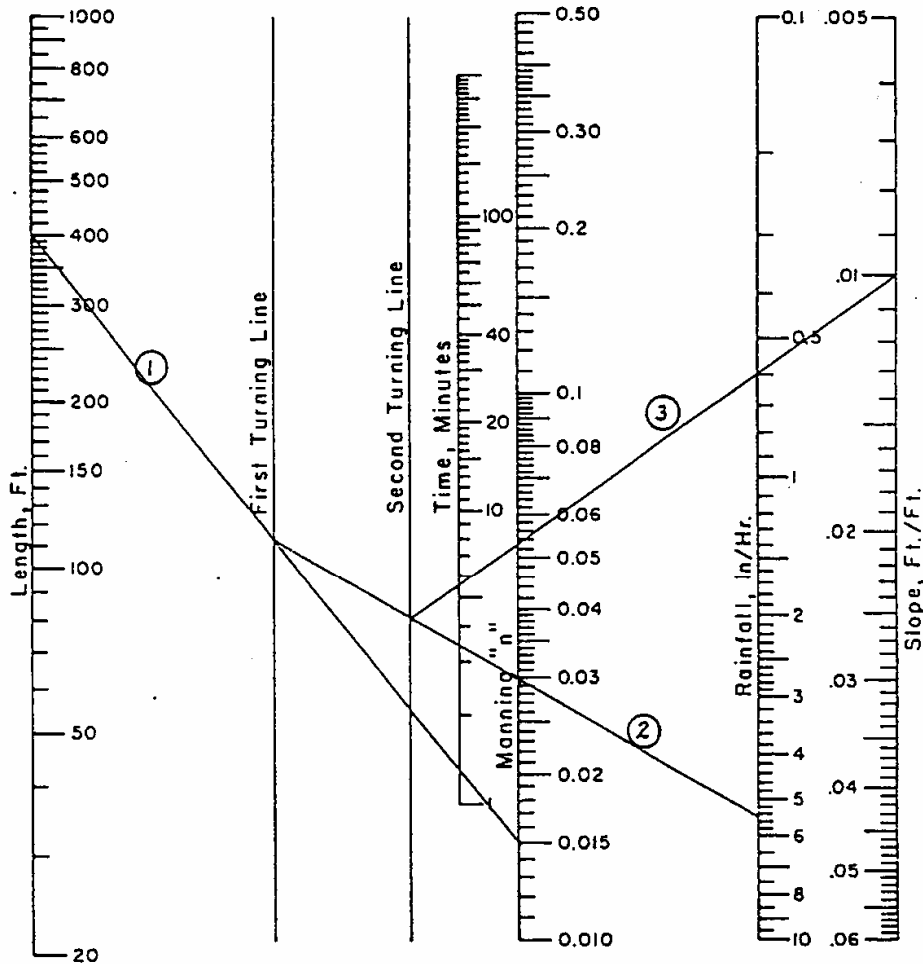


Appendix 6D-2

Kinematic Wave Formulation
Overland Flow

Equation solved by nomograph:

$$t_c (\text{min}) = .93 \frac{L^{0.6} n^{0.6}}{i^{0.4} S_o^{0.3}}$$



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

¹ The n values are a composite of information compiled 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 1.2 inches. This is the only part of the plant cover that will obstruct sheet flow.

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