GRAPHICAL SOLUTION OF CHANNEL DIMENSIONS

The discussion on design of ditches beginning on page 14-19 gives factors to be considered:

1. Ditch bottom width
2. Ditch side slopes
3. Ditch depth
4. Grade of ditch bottom
5. Roughness coefficient, "n"
6. Permissible ditch velocity
7. Actual ditch velocity

These factors have all been considered in the attached set of charts which may be useful in channel design. Any of the variable factors can be determined if the others are known or assumed.

The use of the charts may be illustrated by the following example:

Given: Runoff = 70 cfs
Grade of ditch bottom "s" = 0.1%
Roughness coefficent "n" = 0.035
Permissible velocity = 3.0 ft/sec

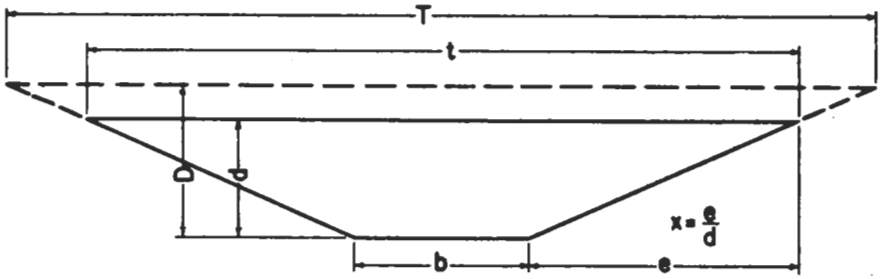
Try a trapezoidal channel with 2:1 side slopes. Determine bottom width and depth.

Go to Exhibit IA14-1, Sheet 2 of 5. Choose a design velocity equal to or less than permissible. For this example, choose 2.0 ft/sec. Find 2 at the bottom right hand side which gives the velocity for an "n" of 0.035; follow this line vertically to the diagonal line which represents an "s" of 0.1%. Next, follow horizontally to the left to the sloping line representing an area of 35 sq. ft. which is required to provide 70 cfs with a velocity of 2.0 ft/sec. ($A = \frac{Q}{v} = \frac{70}{2} = 35$).

After intersection, follow the dashed lined to the left of the page which gives the required depth as 2.8 ft. Next follow vertically downward from the point of intersection to the bottom of the chart where the bottom width is determined to be 7 ft.

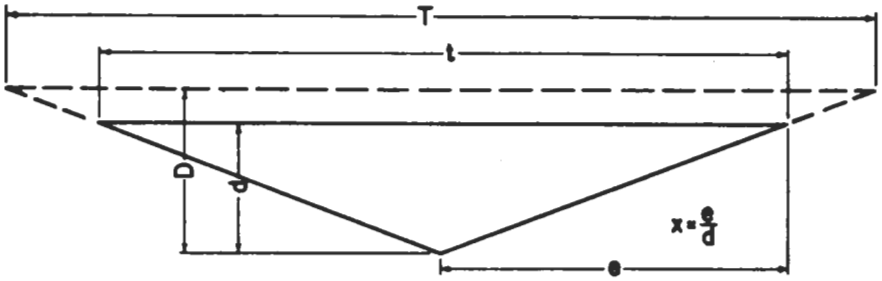
The solution is a channel with 7 ft. bottom width, 2:1 side slopes, and depth of flow of 2.8 ft.

Note: Freeboard = D−d for all sections.



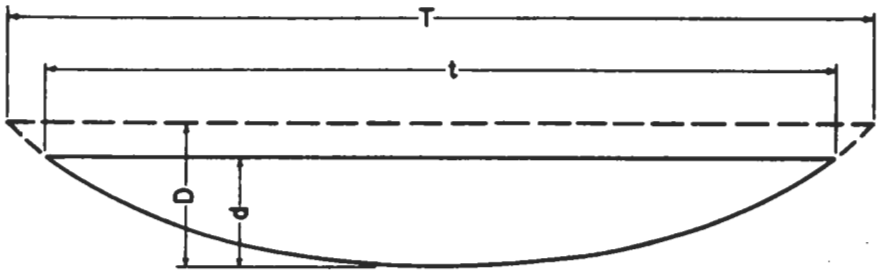
Cross-Sectional Area (A)	Wetted Perimeter	Hydraulic Radius (R)	Top Width (t)
$bd + xd^2$	$b + 2d\sqrt{x^2+1}$	$\frac{bd + xd^2}{b + 2d\sqrt{x^2+1}}$	$b + 2dx$

Trapezoidal Cross Section



xd^2	$2d\sqrt{x^2+1}$	$\frac{xd}{2\sqrt{x^2+1}}$	$2dx$

Triangular Cross Section

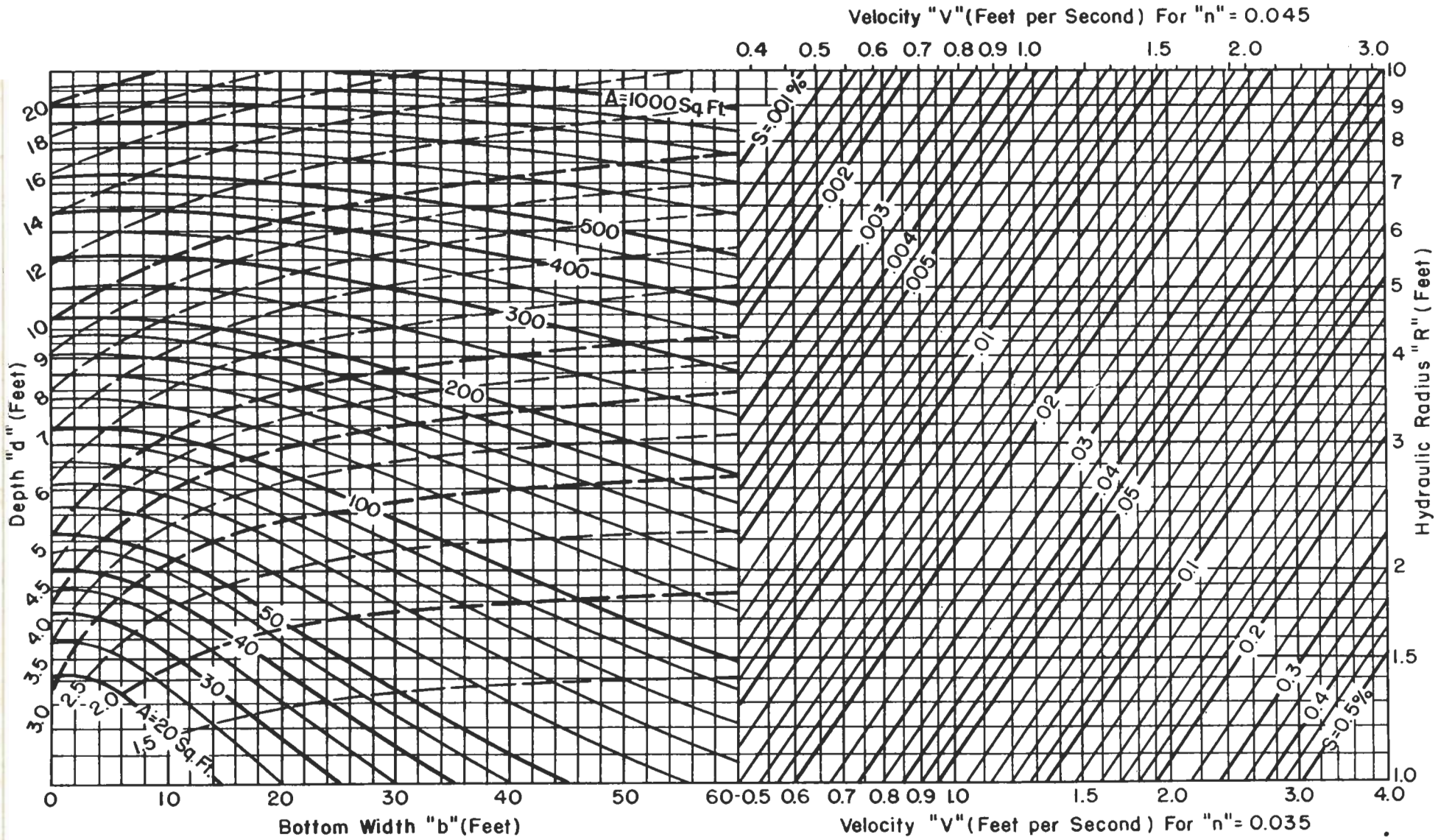


$\frac{2}{3}td$	$t + \frac{8d^2}{3t}$	$\frac{t^2d}{1.5t^2+4d^2}$	$\frac{A}{0.67d}$

Parabolic Cross Section

CHANNEL CROSS SECTIONS, NOTATIONS, AND FORMULAS

Exhibit IA14-1



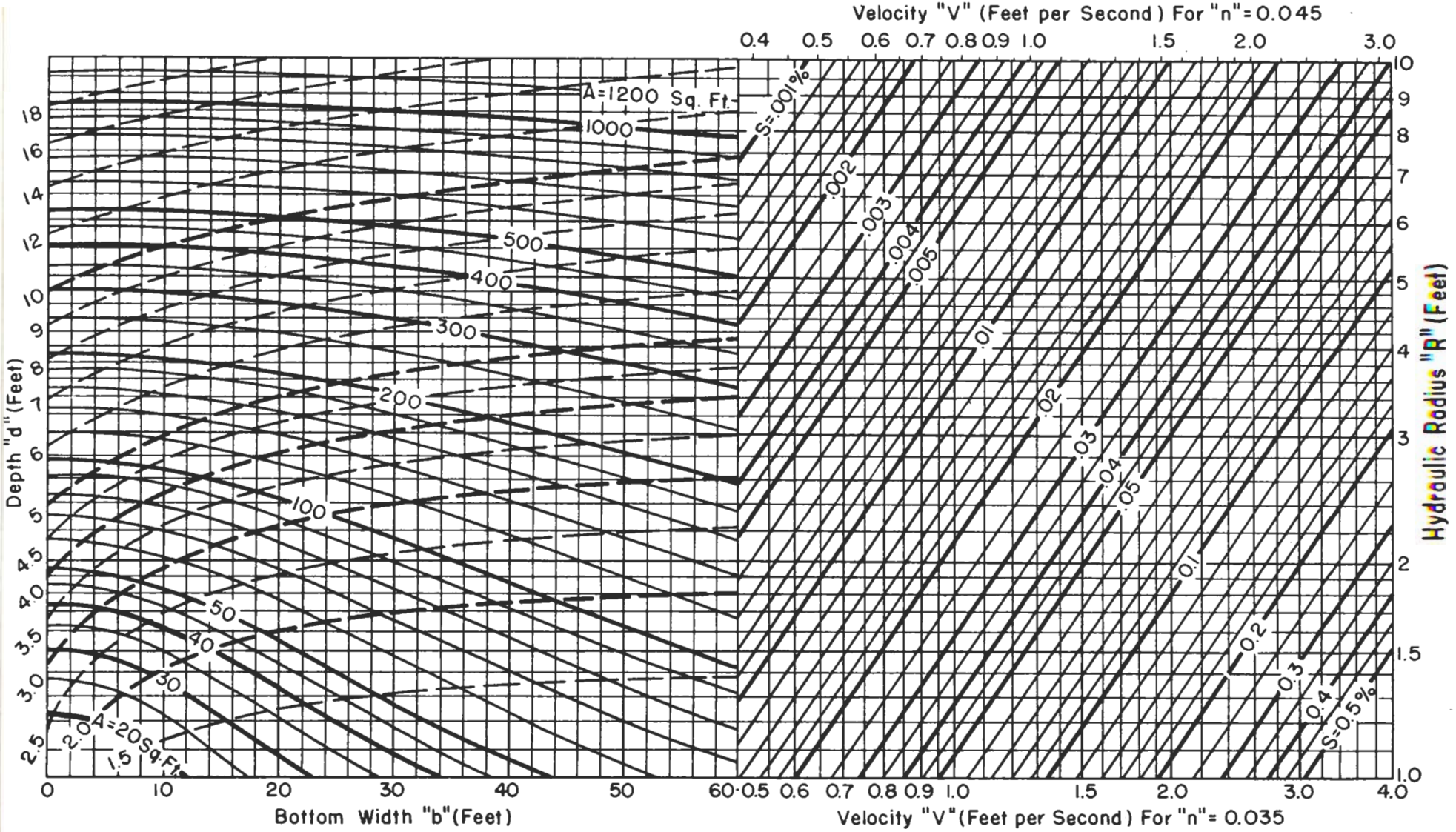
GRAPHIC SOLUTION OF DRAINAGE CHANNEL DIMENSIONS (Trapezoidal Cross Section with 2:1 Side Slopes)

By Manning Formula

Top Width = Bottom Width + 4 Depth

Exhibit IA14-1

Sheet 2 of 5



GRAPHIC SOLUTION OF DRAINAGE CHANNEL DIMENSIONS (Trapezoidal Cross Section with 3:1 Side Slopes)

By Manning Formula

Top Width = Bottom Width + 6 Depth

Exhibit IA14-1