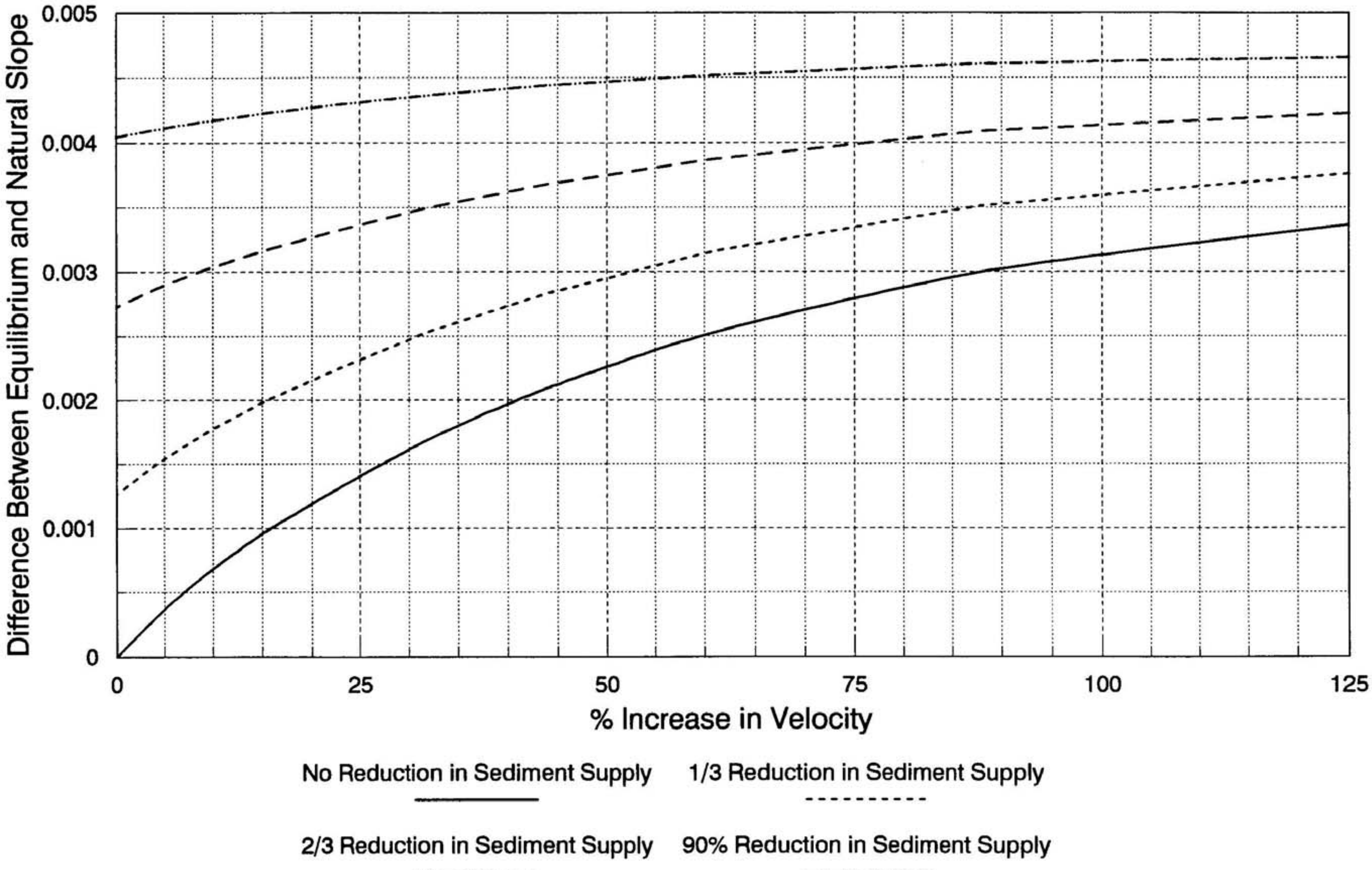
APPENDIX C

Sedimentation Design Curves

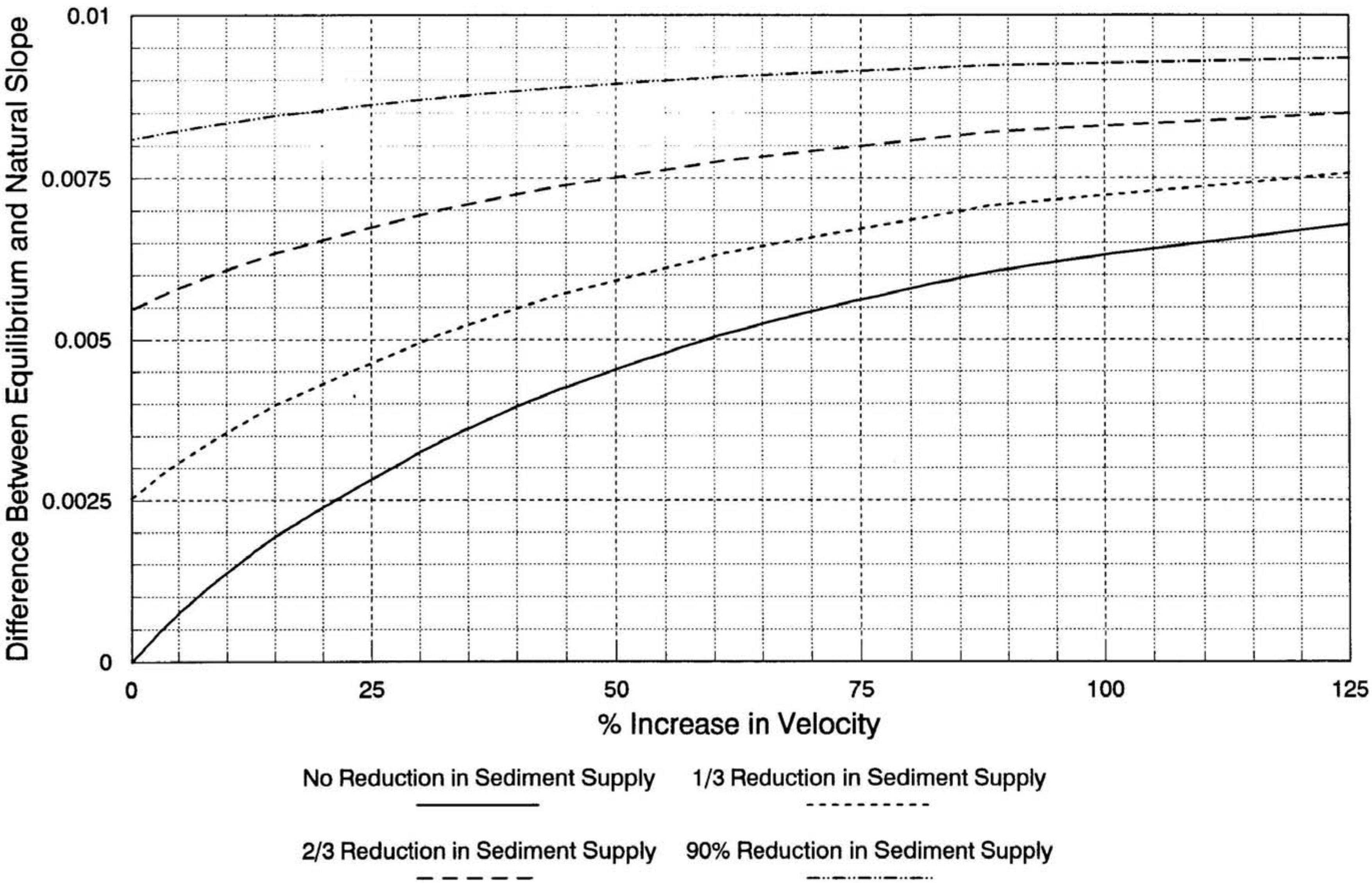
EQUILIBRIUM SLOPE

Natural Slope = 0.005



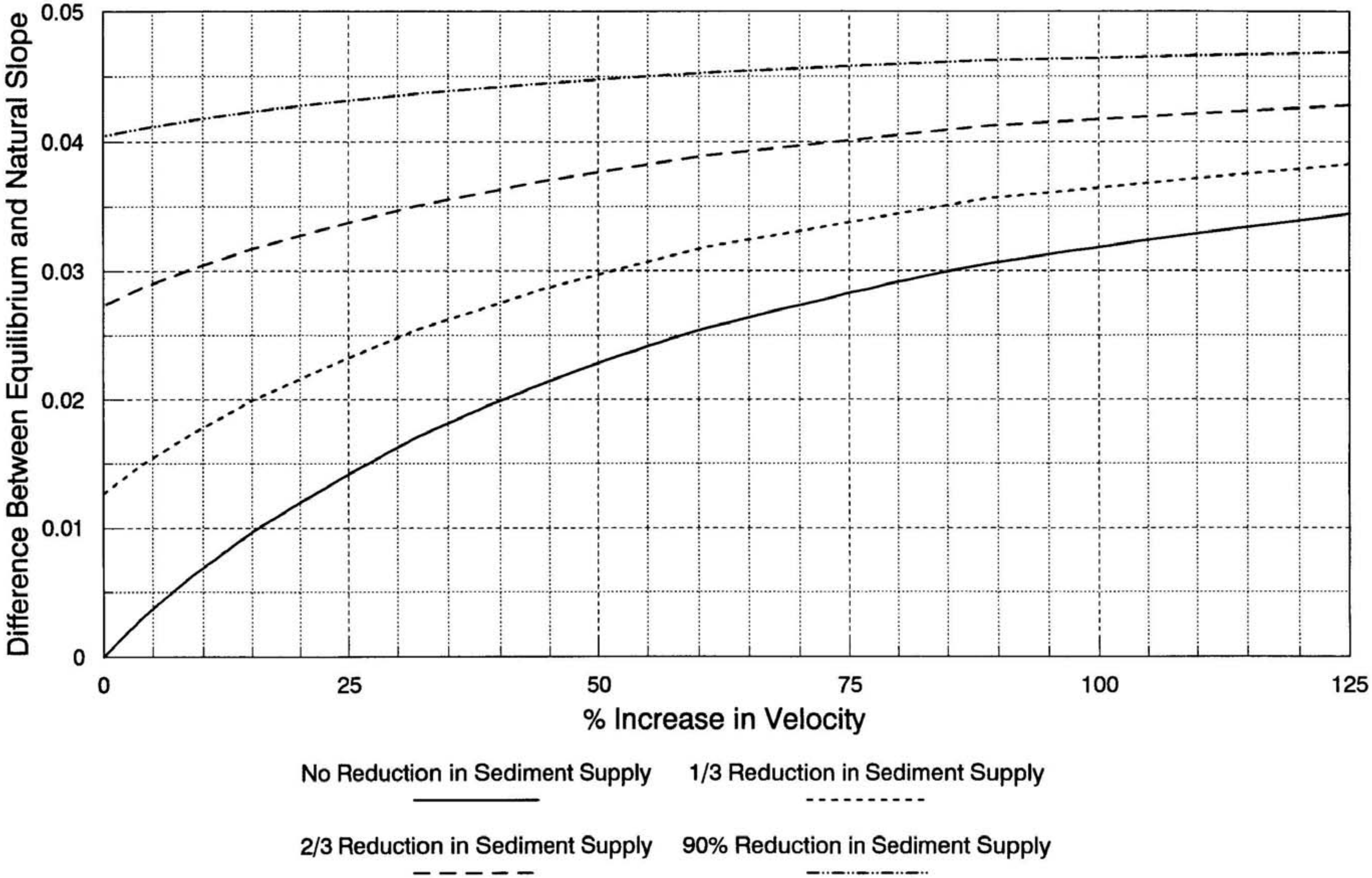
EQUILIBRIUM SLOPE

Natural Slope = 0.01

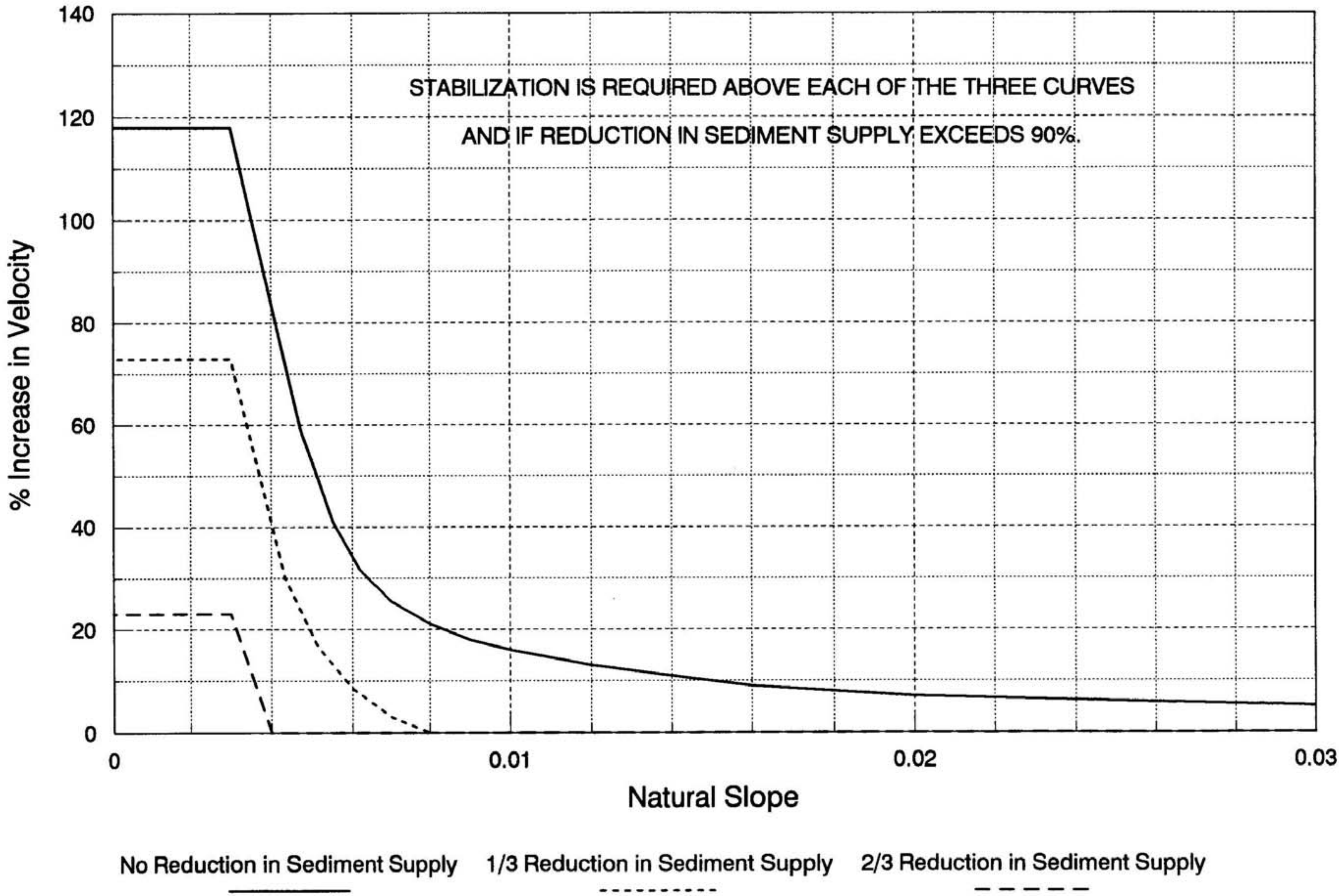


EQUILIBRIUM SLOPE

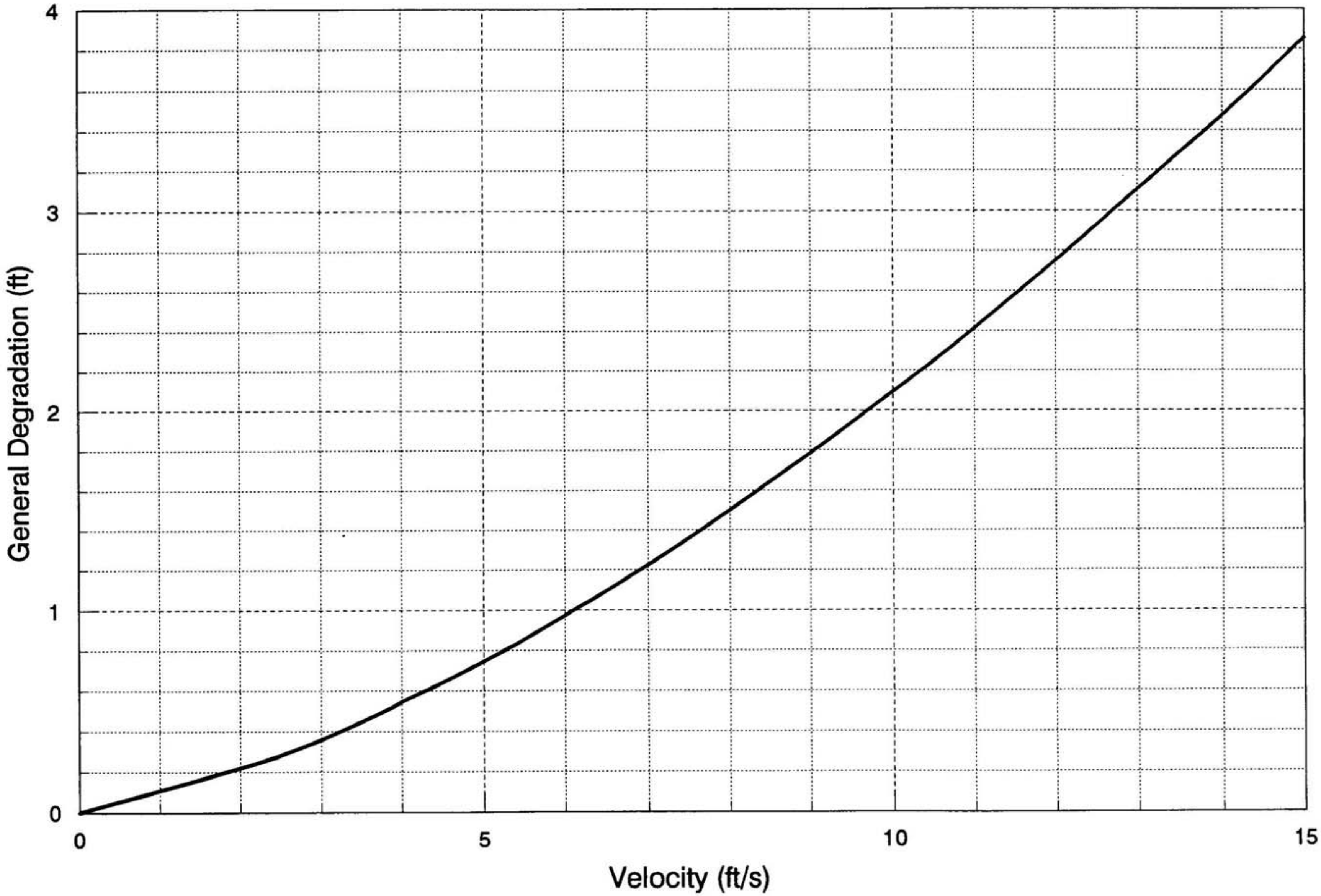
Natural Slope = 0.05



STABILIZATION REQUIREMENTS

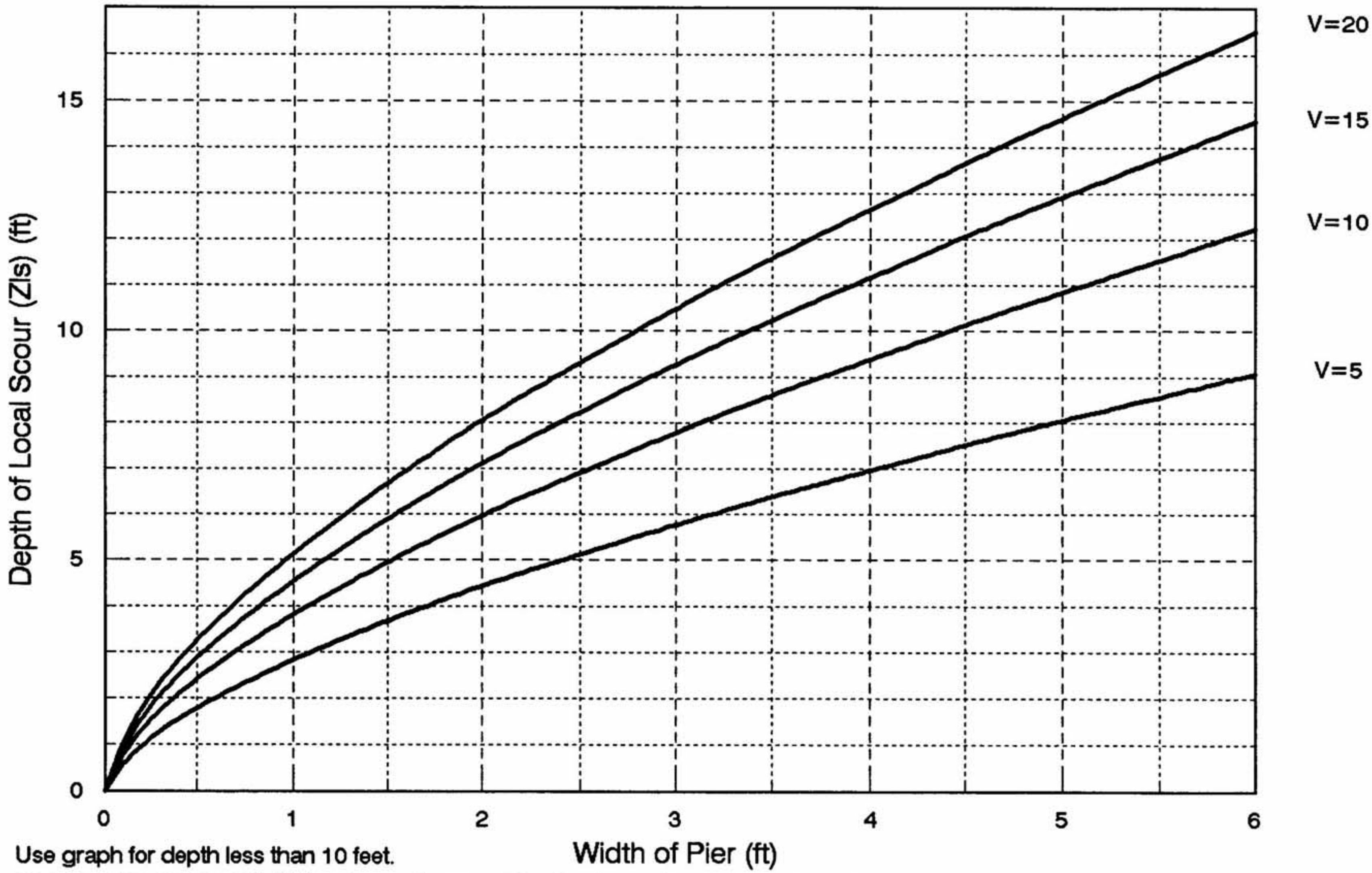


GENERAL DEGRADATION



PIER LOCAL SCOUR

For Square Nose Piers

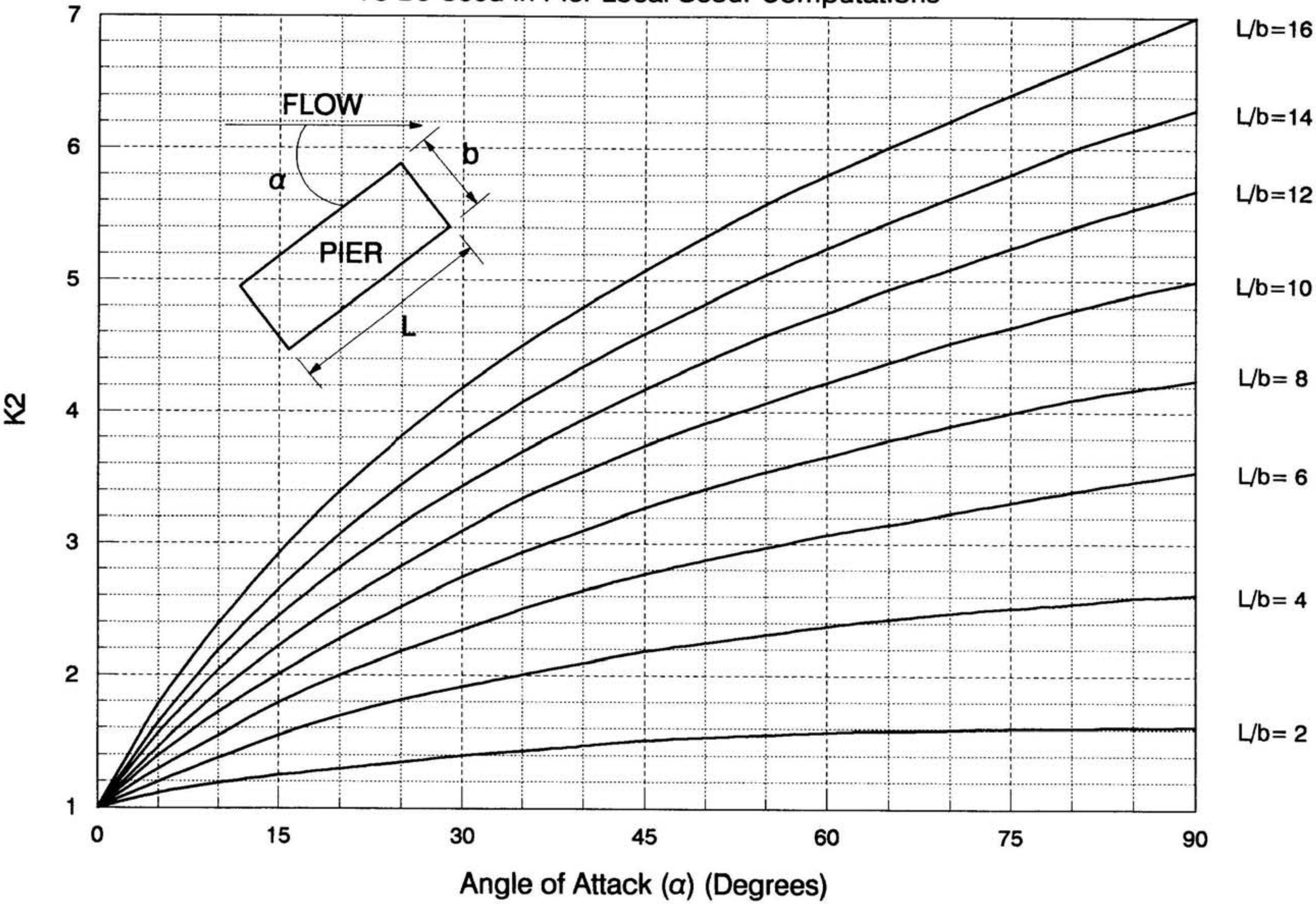


Use graph for depth less than 10 feet.
Use equation on page Q-12 for deeper flows

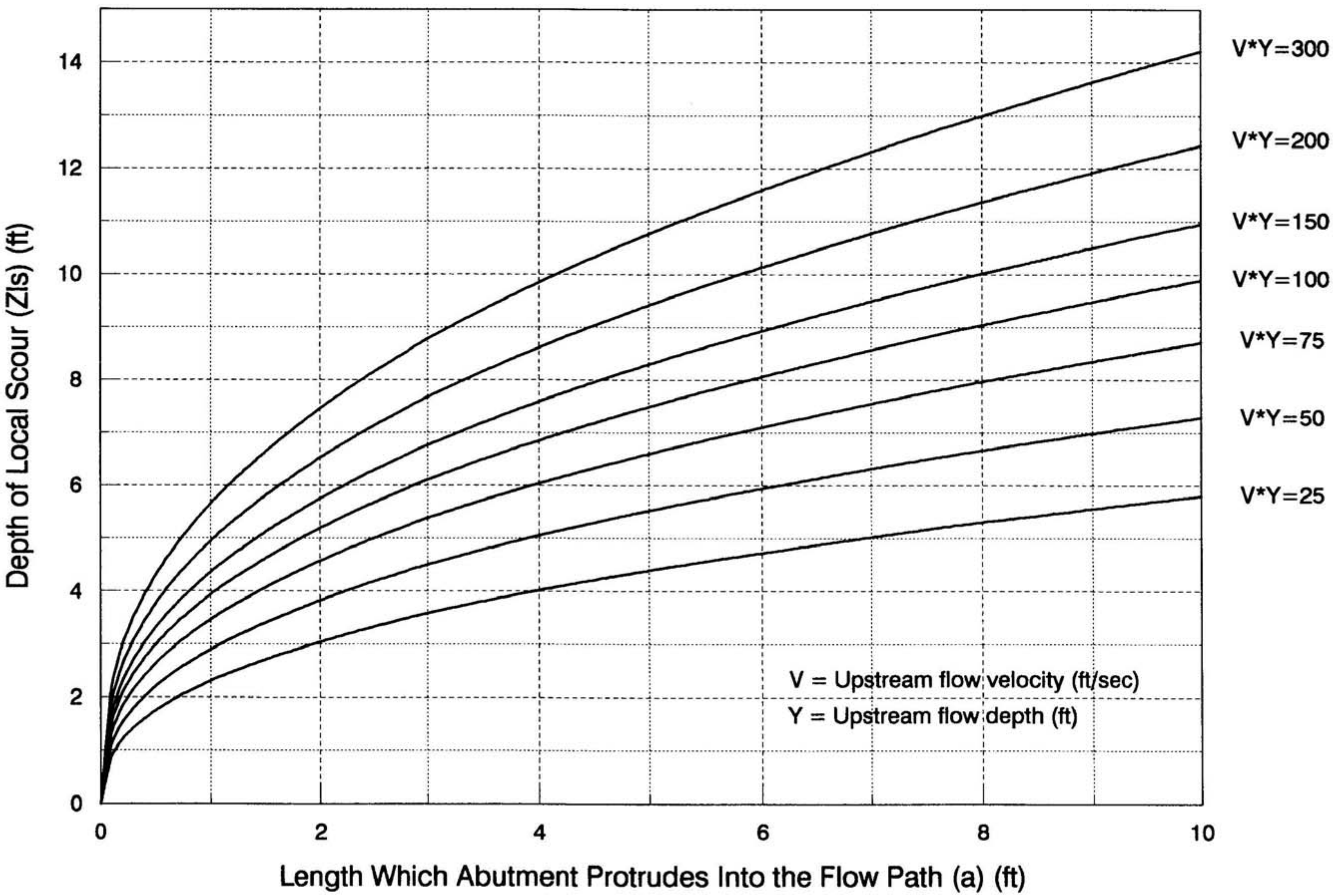
V = Upstream flow velocity (ft/sec)

MULTIPLYING FACTORS FOR ANGLE OF ATTACK

To Be Used In Pier Local Scour Computations

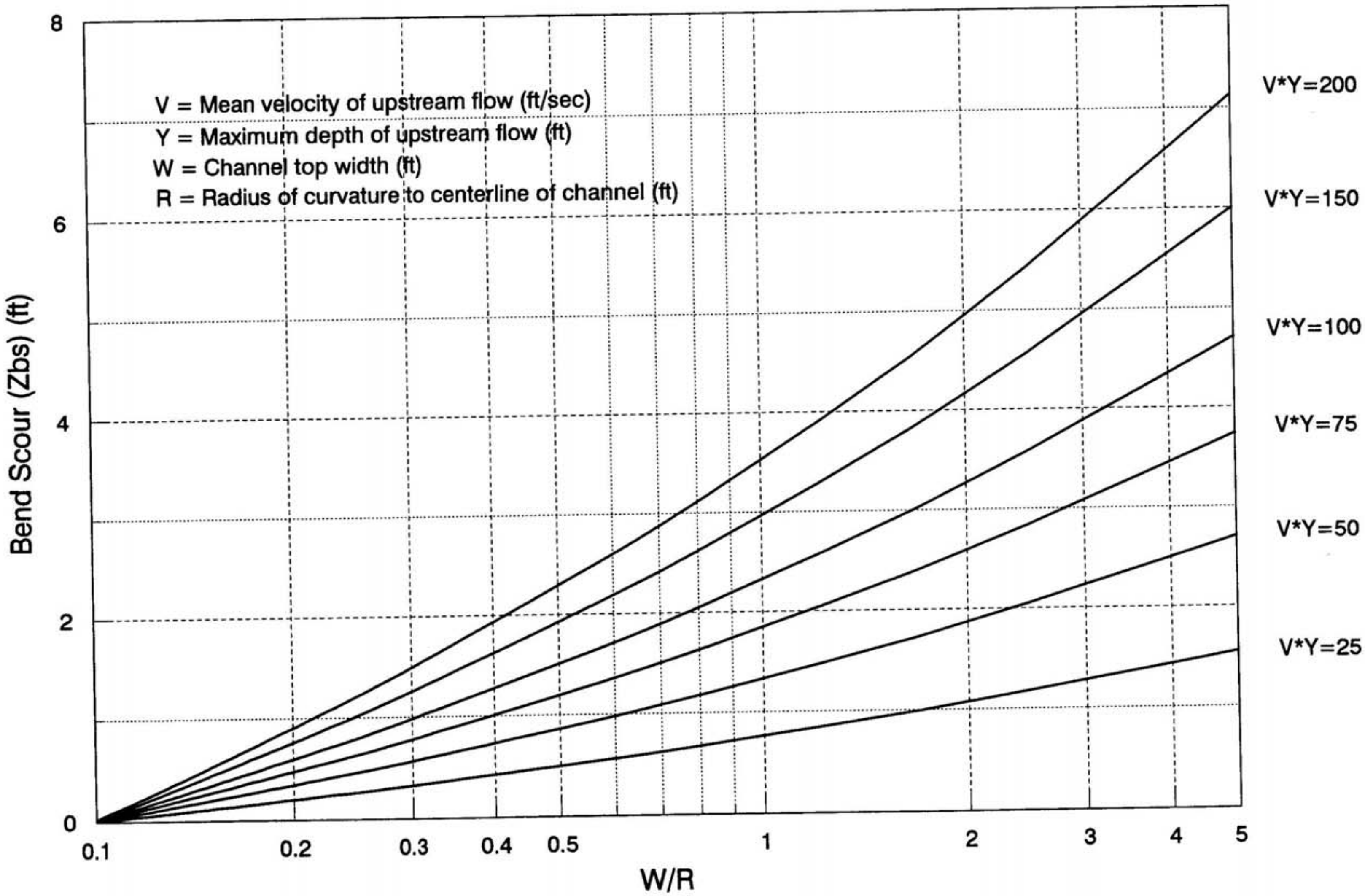


ABUTMENT LOCAL SCOUR



BEND SCOUR

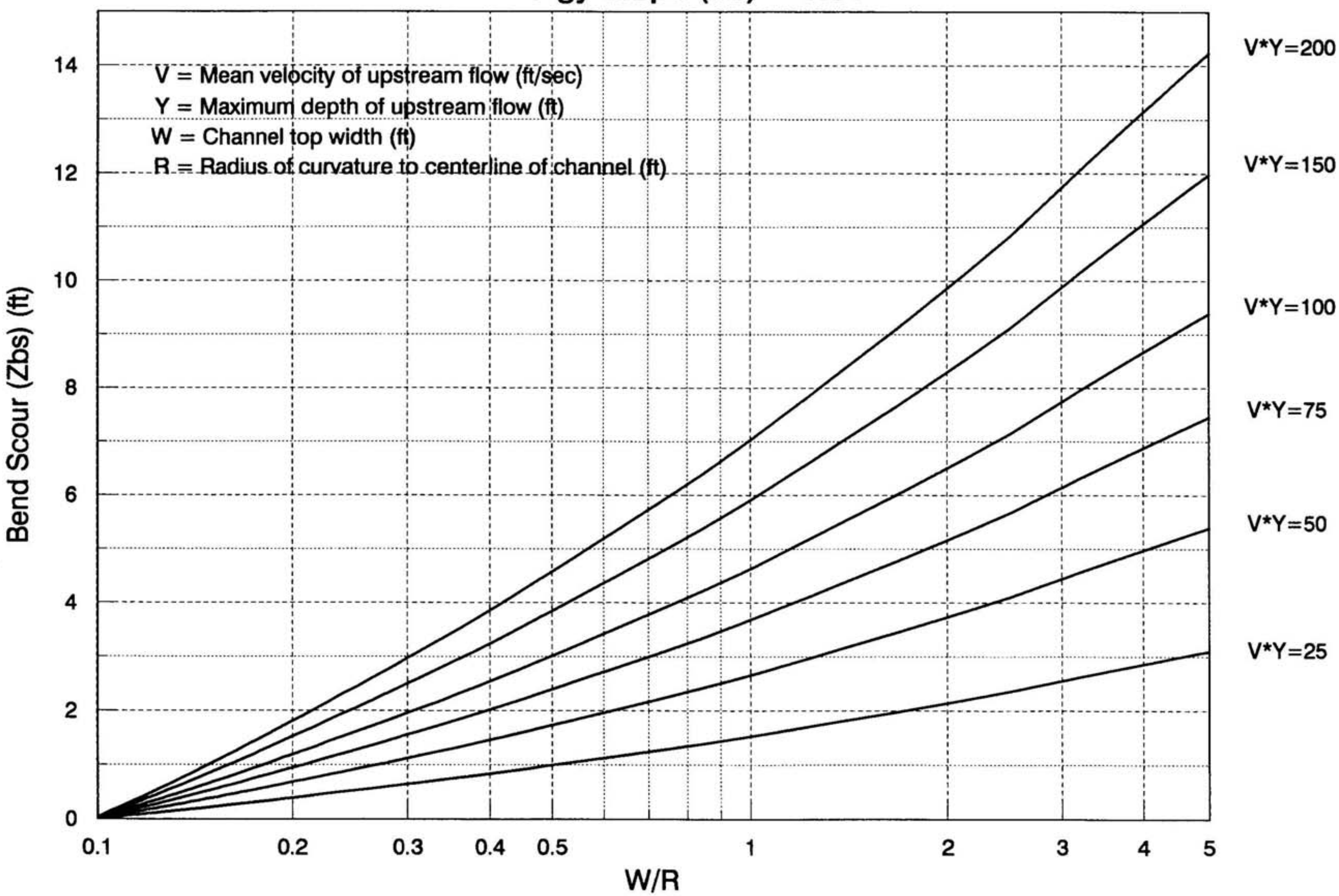
Energy Slope (Se) = 0.1

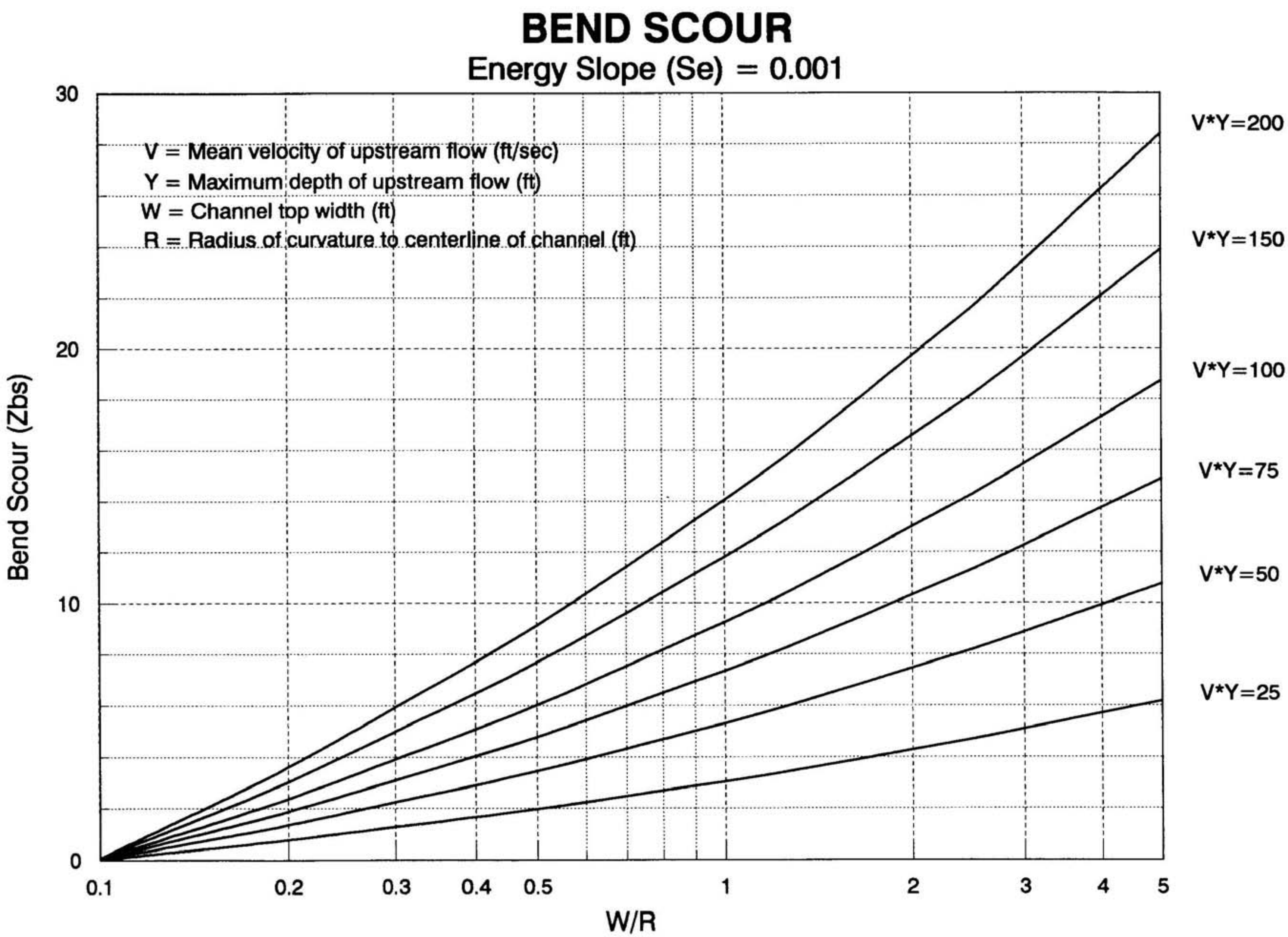


For Se other than 0.1, 0.01, and 0.001 use linear interpolation or extrapolation

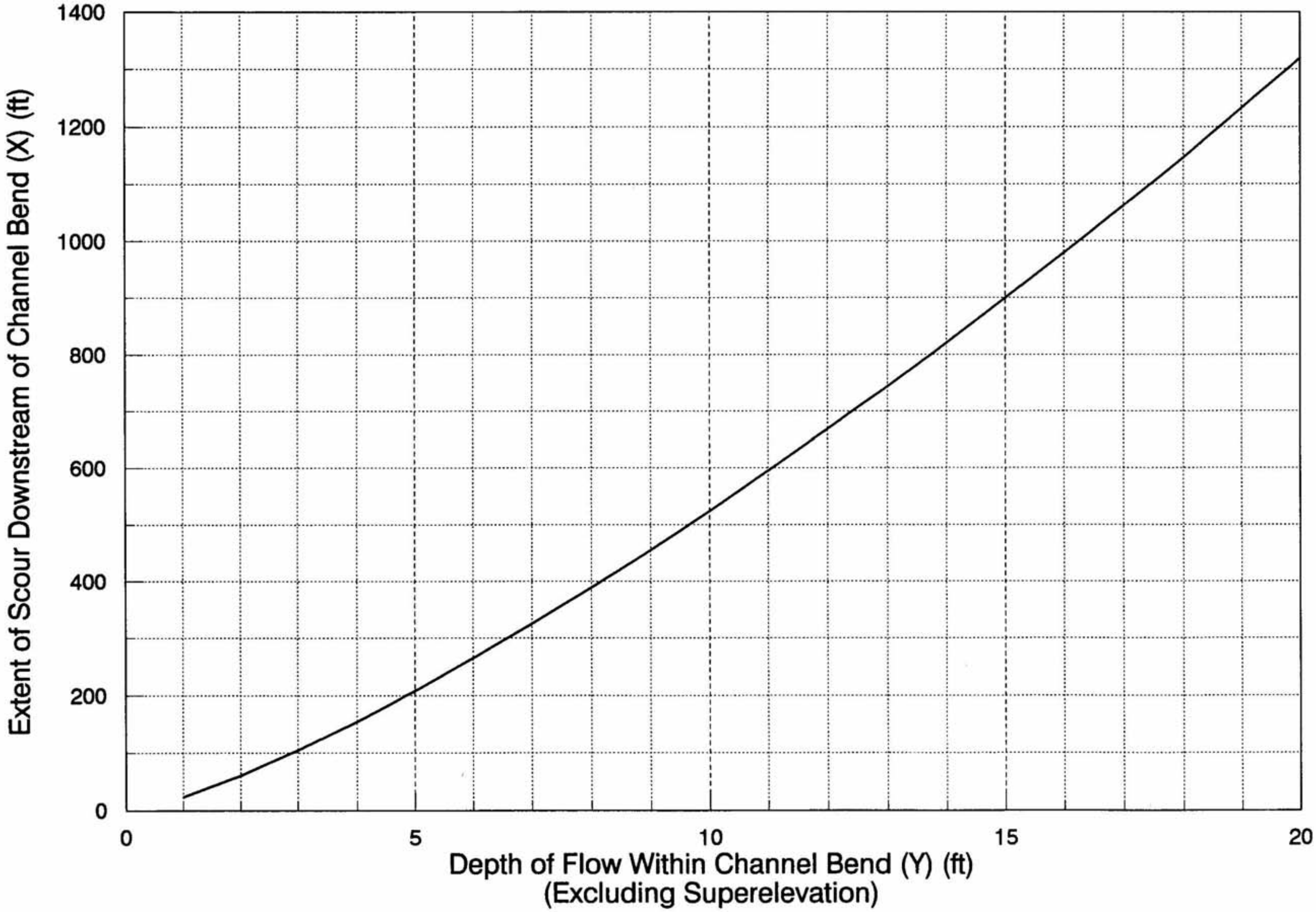
BEND SCOUR

Energy Slope (Se) = 0.01

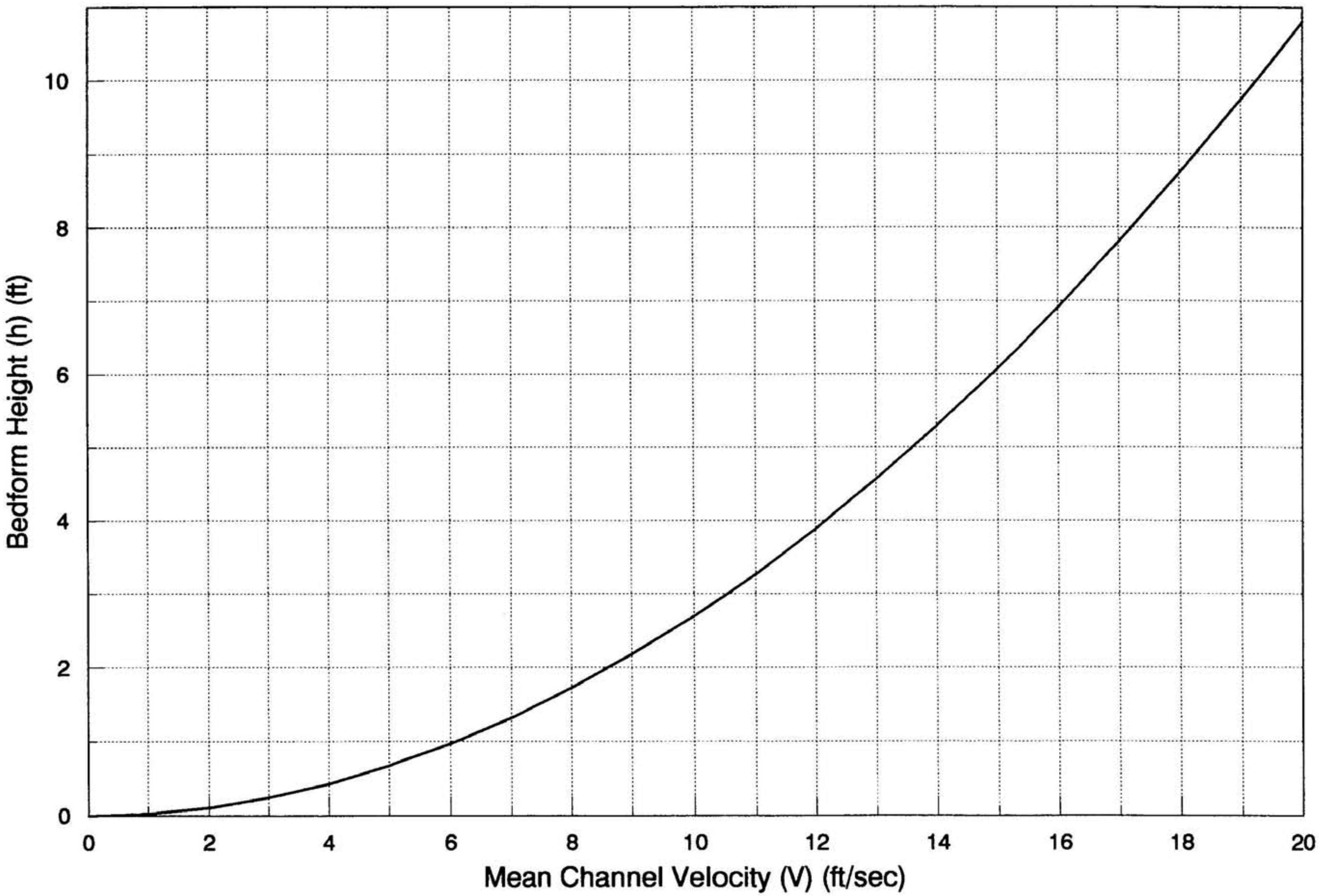



BEND SCOUR
Energy Slope (Se) = 0.001
V = Mean velocity of upstream flow (ft/sec)
Y = Maximum depth of upstream flow (ft)
W = Channel top width (ft)
R = Radius of curvature to centerline of channel (ft)
Bend Scour (Zbs)
W/R
V*Y=200
V*Y=150
V*Y=100
V*Y=75
V*Y=50
V*Y=25
30
20
10
0
0.1
0.2
0.3
0.4
0.5
1
2
3
4
5

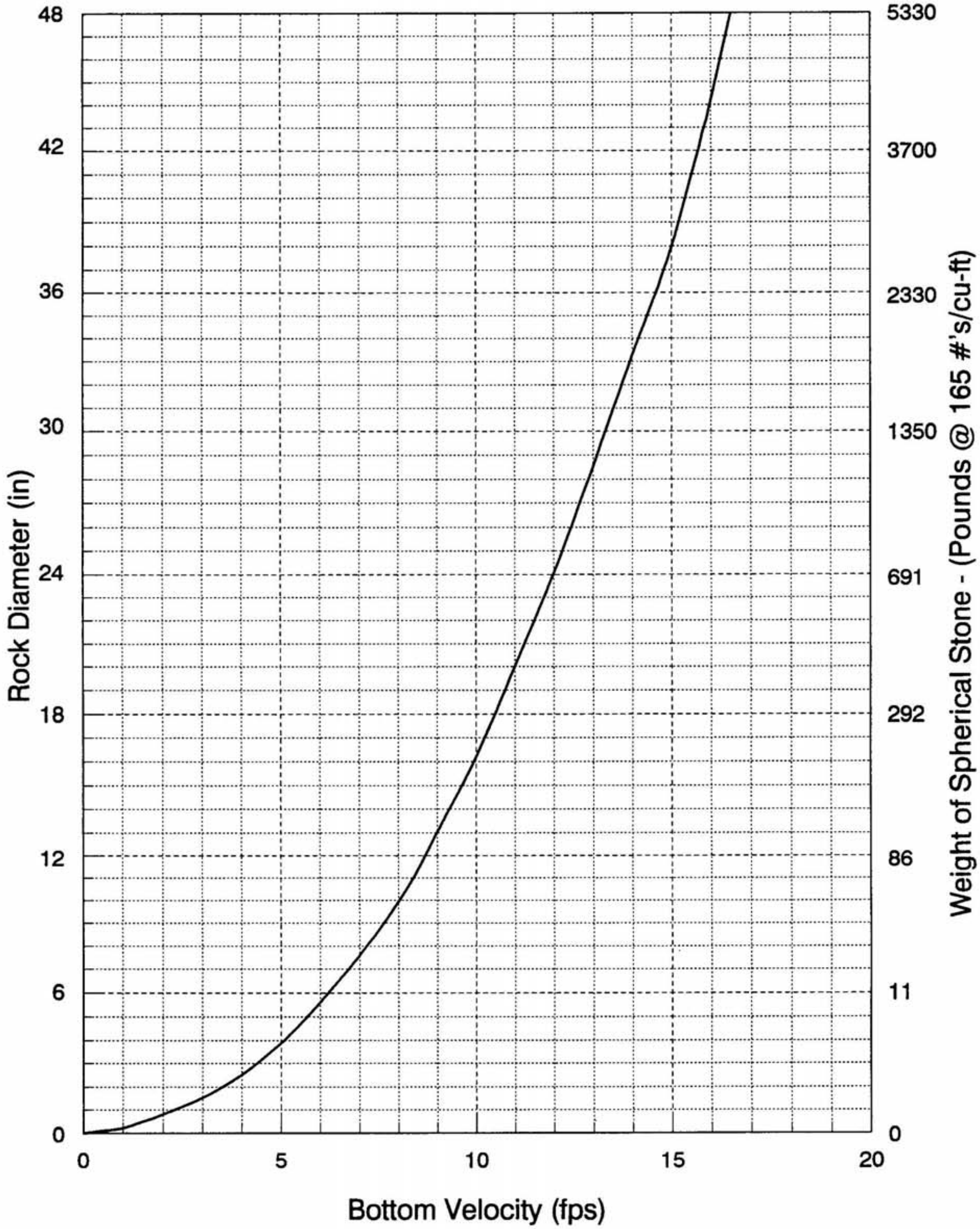
LONGITUDINAL EXTENT OF BEND SCOUR



BEDFORM HEIGHT



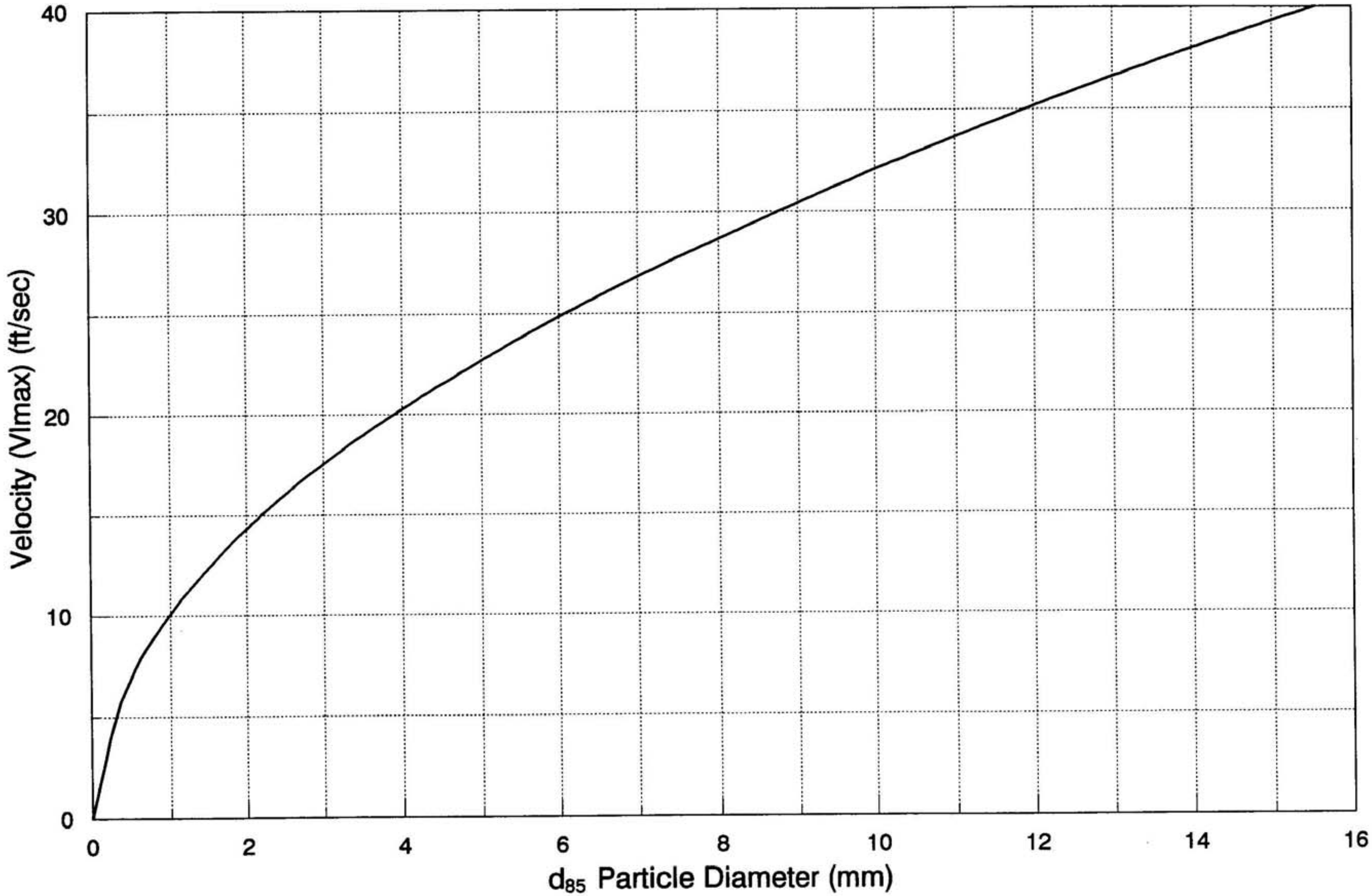
RIPRAP ROCK SIZE



For rock with specific gravity = 2.65

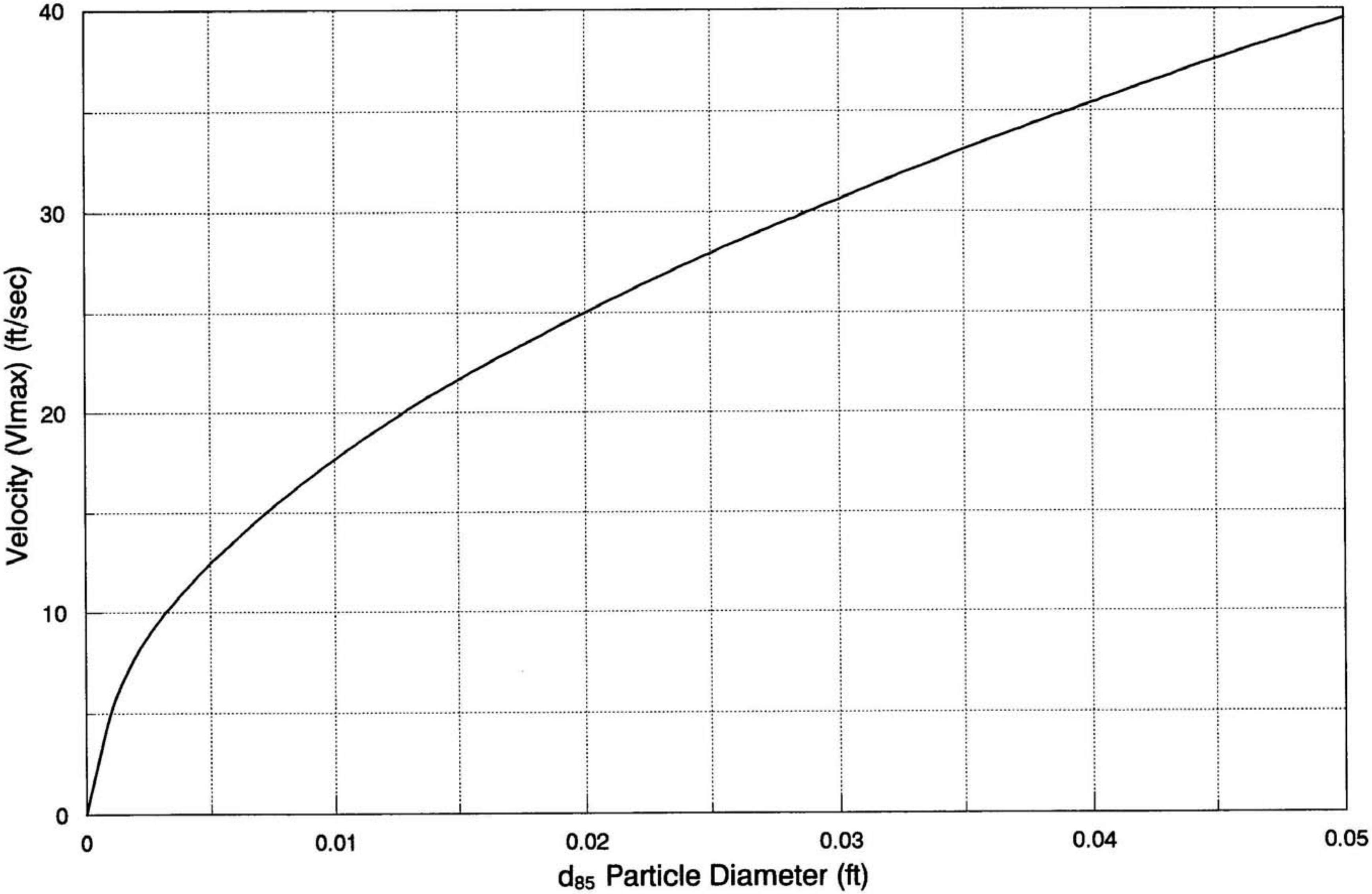
Source: Bureau of Reclamation

LIMITING DEPOSIT VELOCITY



d_{85} = The size of sediment, in mm, for which 85% of the sediment is finer

LIMITING DEPOSIT VELOCITY



d_{85} = The size of sediment, in ft, for which 85% of the sediment is finer

SEDIMENTATION DESIGN CURVES
SOURCE EQUATIONS

Pier Local Scour (Appendix page Q-3):

$$Z_{ls} = (1.04)\, b^{0.65}\, V^{0.43}\, Y^{0.135}$$ (Neill, 1964)

where:
- Z_{ls} = Local scour depth at bridge piers, in feet
- b = Pier width normal to the direction of flow, in feet
- V = Upstream flow velocity, in ft/sec
- Y = Upstream flow depth, in feet.

Abutment Local Scour (Appendix page Q-5):

$$Z_{lsa} = (0.62)\, a^{0.40}\, V^{0.33}\, Y^{0.44}$$ (Lin, 1961)

where:
- Z_{lsa} = Depth of local scour due to an abutment, in feet
- a = Length which abutment protrudes into the flow path, in feet
- V = Upstream flow velocity, in ft/sec
- Y = Upstream flow depth, in feet.

Bend Scour (Appendix page Q- 6A-C):

$$Z_{bs} = \frac{0.0685\, Y\, V^{0.8}}{Y_h^{0.4}\, S_e^{0.3}} \left[1.59 \left(\frac{w}{r} \right)^{0.2} - 1 \right]$$ (Zeller, 1981)

where:
- Z_{bs} = Bend scour component of total scour depth, in feet
- V = Mean velocity of upstream flow, in ft/sec
- Y = Maximum depth of upstream flow, in feet
- Y_h = Hydraulic depth of upstream flow, in feet
- S_e = Upstream energy slope
- w = Channel top width, in feet
- r = Radius of curvature to centerline of channel, in feet.

Longitudinal Extent of Bend Scour (Appendix page Q-7):

$$\boldsymbol{X = (0.41)\,C\,Y}$$ (Rozovski, 1961)

where: X = Distance from the end of channel curvature to the downstream point at which secondary currents have dissipated, in feet

C = Chezy coefficient (see equation below)

Y = Depth of flow within the channel bend (not including scour), in feet.

The Chezy coefficient may be determined from the expression:

$$\boldsymbol{C = \frac{1.486}{n} R^{1/6}}$$

where: n = Manning roughness coefficient for the channel

R = Hydraulic radius.

Bed form Height (Appendix page Q-8):

$$\boldsymbol{h = 0.14\,\frac{2\,\pi\,V^2}{g} = 0.027\,V^2}$$ (Kennedy, 1963)

where: h = Bed form height

V = Mean channel velocity

g = Acceleration of gravity.

Limiting Deposit Velocity - d_{85} (Appendix pages Q- 10A-B):

In mm:

$$\mathbf{V_{lmax}^2 = 103\ d_{85}}$$ (Sinclair, 1962)

where: V_{lmax} = Maximum limiting deposit velocity, in ft/sec

d_{85} = The size of sediment for which 85% of the transported sediment is finer, in **mm.**

In feet:

$$\mathbf{V_{lmax}^2 = 31{,}300\ d_{85}}$$ (Sinclair, 1962)

where: V_{lmax} = Maximum limiting deposit velocity, in ft/sec

d_{85} = The size of sediment for which 85% of the transported sediment is finer, in **feet**.