Culvert Hydraulics (Outlet Control) – Cont'd

Total energy loss $H_L = (He + Hf + Ho)$

Where: He = Entrance loss = $Ke \frac{Vo^2}{2g}$

Ke = Entrance loss coef.

Type of Entrance	Ke
Manufactured apron (PC & metal)	0.5
RCP groove	0.2
Projecting metal end	0.9
Mitered metal end	0.7

Hf = Friction loss $= \left(\frac{29n^2L}{R^{(4/3)}}\right) X \frac{Vo^2}{2g}$

R = Hydraulic radius = A/P

A = Area below water surface, in barrel, sqft

P = Wetted Perimeter of the barrel, ft

n = Manning's roughness coefficient (See Table)

Ho = Outlet loss $= \left(\frac{Vo^2}{2g} - \frac{Vd^2}{2g}\right)$

$HW = HWo - SoL$

Where: HW = Headwater depth at inlet

Substituting and simplifying

$$HW = TW - SoL - \frac{Vu^2}{2g} + \left(\frac{Vo^2}{2g}\right) X \left(1 + Ke + \frac{29n^2L}{R^{(4/3)}}\right)$$

Stage Increase, S.I.

$S.I. = HW - TW$