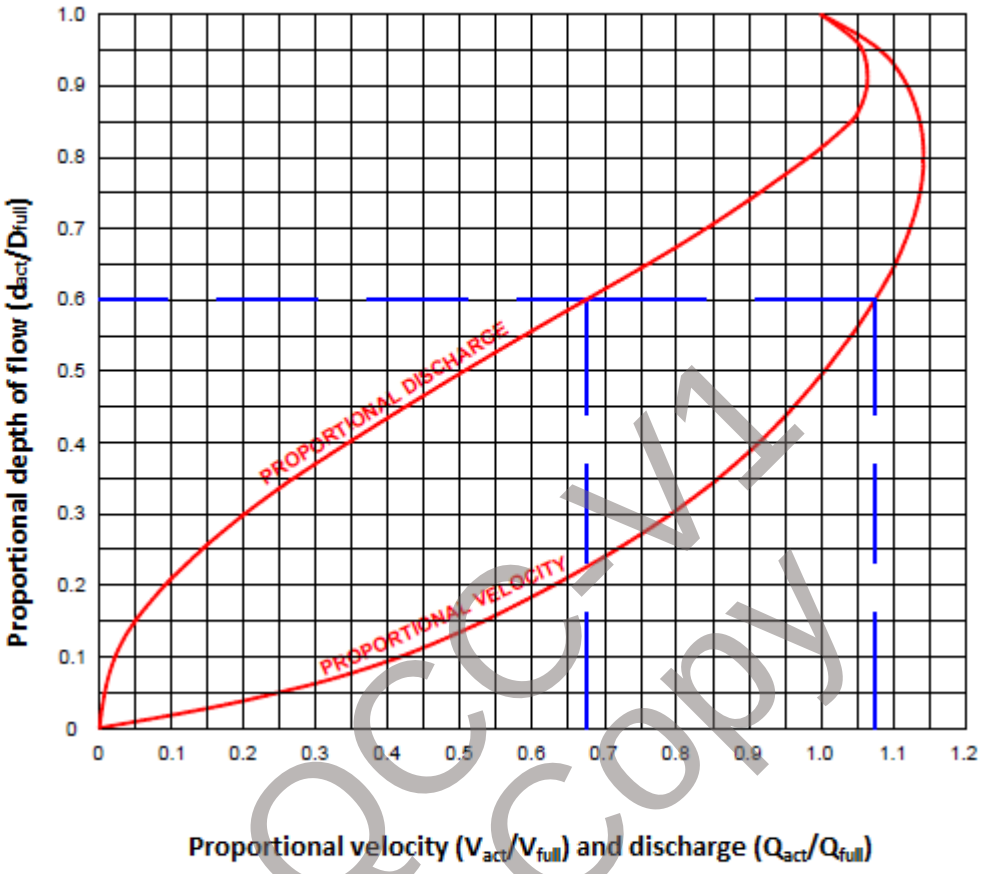

Figure 4-2 - Relative velocity and discharge in a circular pipe for any depth of flow Alternatively the Consultant may use the Manning formula

The Manning formula is normally used where there is 'free surface' flow and is given by:

$$V = 1/n\ (R^{2/3})\ (S^{1/2})$$

Where:

V = velocity (m/s)

n = Manning coefficient

R = hydraulic radius (area of flow ÷ wetted perimeter (A/P))

S = Pipeline gradient

The roughness values to be used for storm water design are tabled below:

Pipe Material	Colebrook-White, K (mm)			Manning's Coefficient (n)
	Good	Normal	Poor	
uPVC Pipes	0.3	0.6	1.5	0.011
GRP Pipes	0.3	0.6	1.5	0.012
HDPE Pipes	0.3	0.6	1.5	0.012
Lined Concrete Pipes	0.3	0.6	1.5	0.011
Un-lined Concrete Pipes*	*0.3	*0.6	*1.5	*0.013

Table 4-1 - Roughness Coefficients

*For Al Ain region only