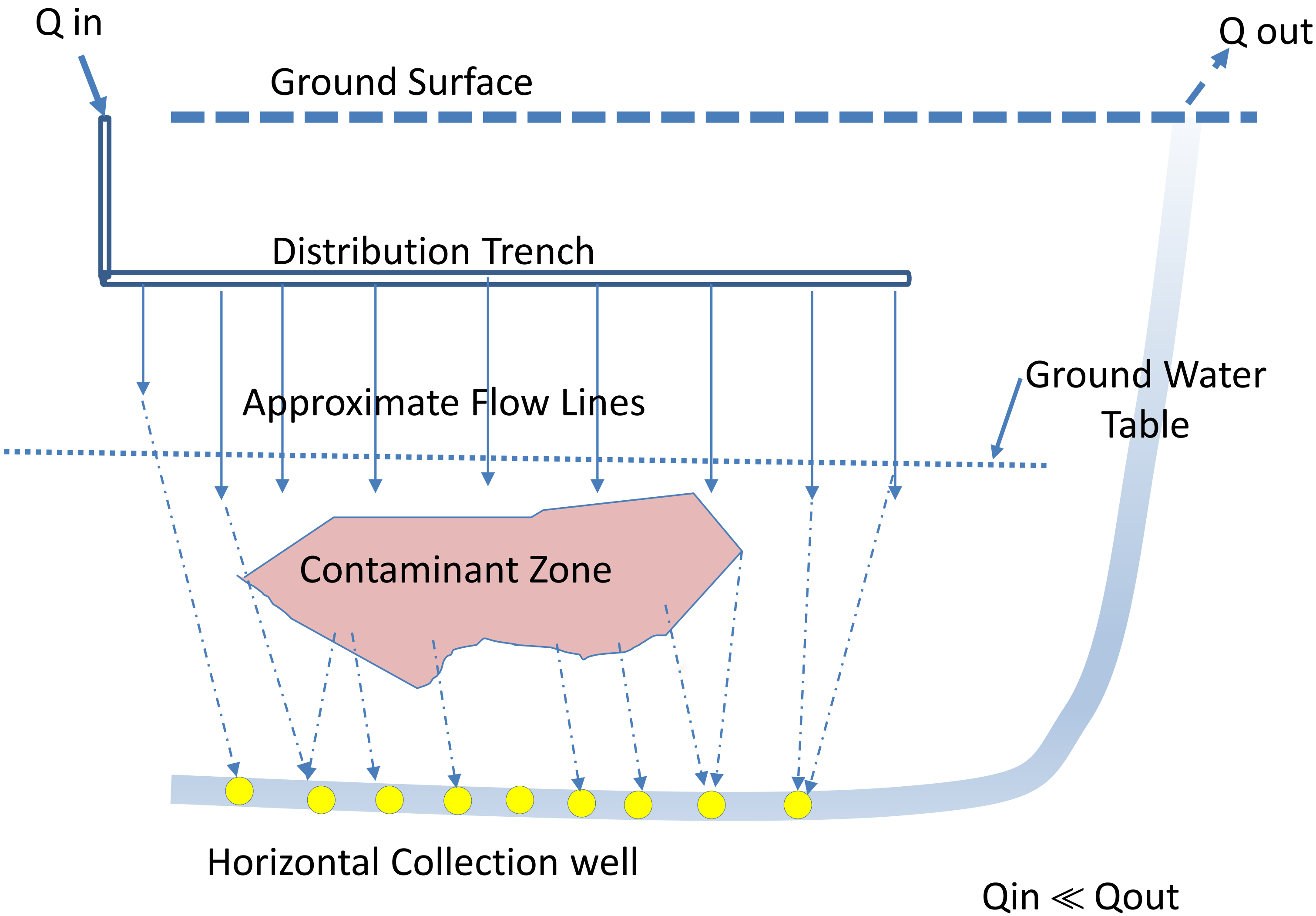
Horizontal Well & Distribution Trench for subsurface cleanup



How do you insure even distribution of fluids or air above or below the contaminant zone?

Understanding Fluid Flow Principles
Orifice Formula for Head Loss:

$$Q = Cd*Ao*[2gh]^{0.5}$$

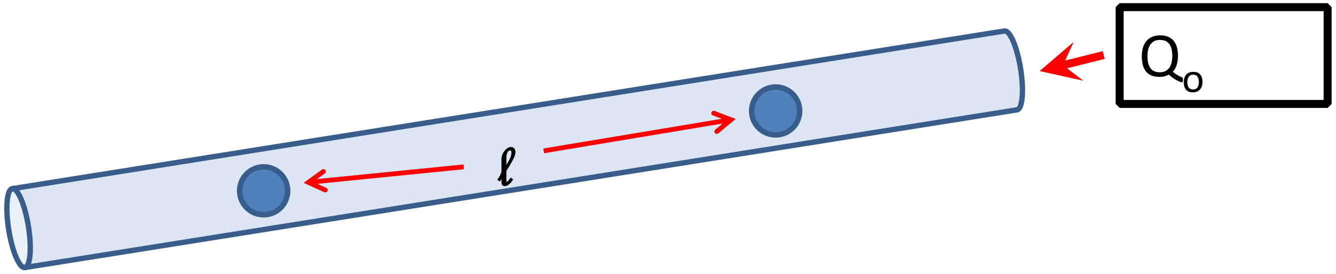
Cd is a coefficient between 0.59 and 0.66 depending upon application

See: Water Resources Bulletin, Vol 28, No 3, June 1992, American Water Resources Association. Article by Duchene and McBean

A Second Approach

$$H_f = (KQ_o^2/L^2)^* (\ell - \ell^2/L + \ell^3/L^2)$$

Where K is the hydraulic coefficient equivalent to the head losses in the total length of the pipe at full flow conditions; L is the length of the pipe, *l* is the fractional length of the pipe where the losses are occurring, and Q_o is the total flow in the pipe at maximum conditions



A Third Method

Set the orifice losses using the first formula higher than the total head loss in the pipe at full flow.

Compressible Flow

- Compressible flow is a bit more difficult because it involves temperature and pressure considerations. The general formula for use, after some simplification is:

$$(4) \qquad Y = \sqrt{r^{2/k}\left(\frac{k}{k-1}\right)\left(\frac{1-r^{(k-1)/k}}{1-r}\right)}$$

Compressible Flow Cont'd

- Where :
- Y = Expansion factor, dimensionless
- r = P_2/P_1 (Absolute pressures)
- k = specific heat ratio (c_p/c_v), dimensionless, but for air it is 1.4 which is good enough for most cases, unless one really has a heavy vapor concentration in the gas. Or get Cv and Cp from the Internet on sites such as: http://www.engineeringtoolbox.com/spesific-heat-capacity-gases-d_159.html

Compressible Flow Concluded

$$Q_1 = C\, A_2 \sqrt{\frac{2ZRT1}{M}\left(\frac{k}{k-1}\right)\left[\left(\frac{P2}{P1}\right)^{\frac{2}{k}} - \left(\frac{P2}{P1}\right)^{\frac{k+1}{k}}\right.}$$

where:

k = specific heat ratio (cp/cv), dimensionless

m = mass flow rate at any section, kg/s

Q_1 = upstream real gas flow rate, m^3/s

C = orifice flow coefficient, dimensionless

A_2 = cross-sectional area of the orifice hole, m^2

P1 = upstream gas pressure, Pa with dimensions of $kg/(m \cdot s^2)$

P2 = downstream pressure, Pa with dimensions of $kg/(m \cdot s^2)$

M = the gas molecular mass, kg/mol (also known as the molecular weight)

R = the Universal Gas Law Constant = 8.3145 J/(mol·K)

T1 = absolute upstream gas temperature, K

Z = the gas compressibility factor at P1 and T1 and , dimensionless—but most of the time it is 1 for air at environmental temperatures generally encountered