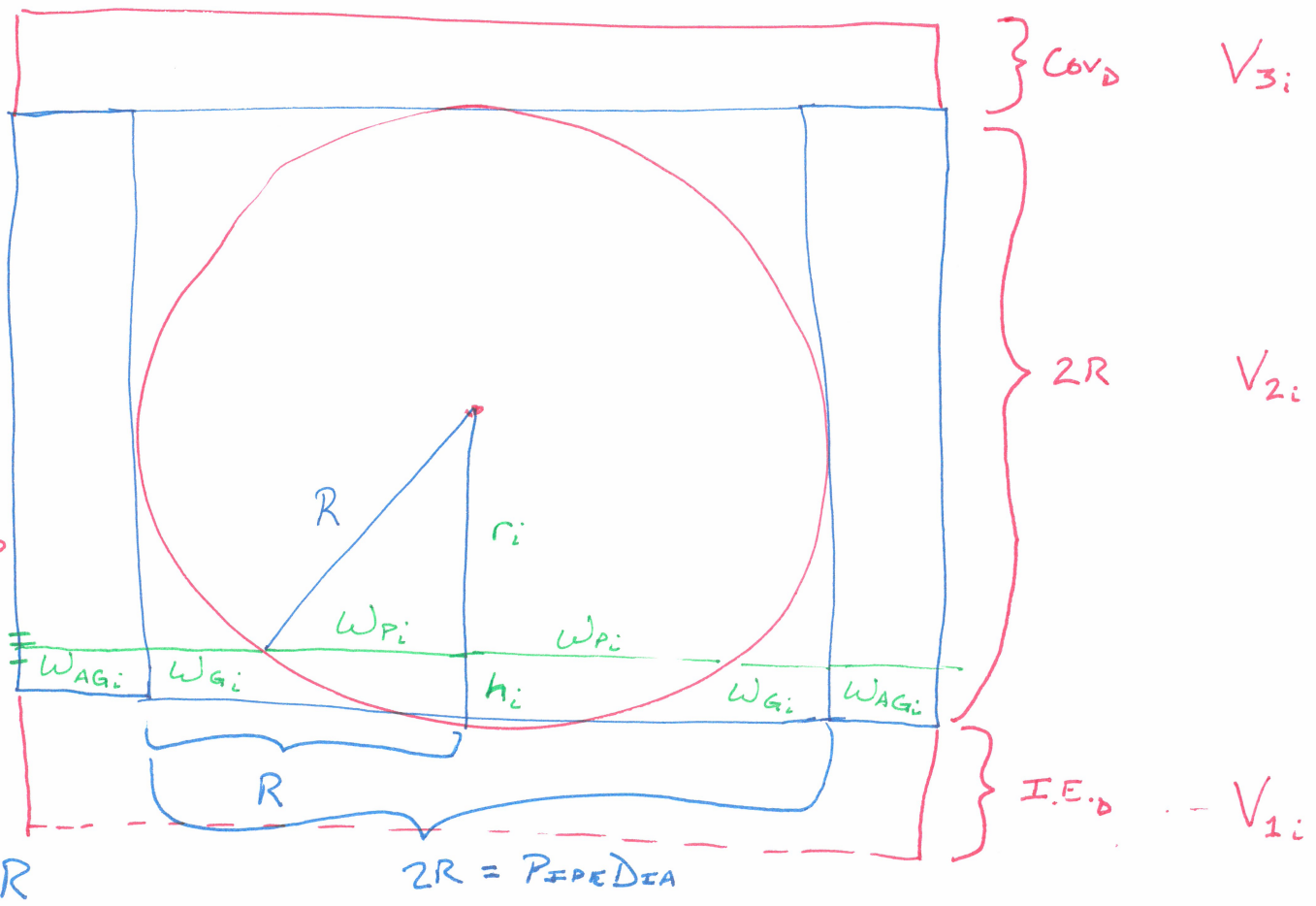
Detention Pipe With Gravel Backfill
SSD Formula Derivation



Given:

- R → Pipe Radius
- L_p → Pipe Length
- A_{sys} → System Footprint
- $I.E._D$ → Depth Of Gravel Below Pipe
- Cov_D → Depth Of Gravel Cover Over Pipe
- S → Gravel Void Raiio (0.33 typ)

$\triangle = h_i - h_{i-1}$

$r_i + h_i = R$

(1) $\boxed{r_i = R - h_i}$

$R^2 = w_{pi}^2 + r_i^2$

$w_{pi}^2 = R^2 - r_i^2$ Sub (1)

(2) $\boxed{w_{pi} = \sqrt{R^2 - (R - h_i)^2}}$

$R = w_{pi} + w_{Gi}$

(3) $\boxed{w_{Gi} = R - w_{pi}}$ Solve For w_{Gi}

$SysVol_{pipe} = A_{sys} \cdot 2R$ Vol Gravel + Pipe IN Pipe Region

(4) $\boxed{w_{AGi} = \dfrac{SysVol_{pipe} - (2R)^2 \cdot L_p}{2R}}$

SysVol_pipe minus Rect. Prism Of Length L_p. & Width equals Height equals $2R$. All Divided By Depth of Prism ($2R$) To Yield Width Of Add'l Gravel

$V_{1i} = \triangle \cdot A_{sys} \cdot S$ For $h_i \in [0, I.E._D)$

$V_{2i} = \triangle \cdot (S(2w_{AGi} + 2w_{Gi}) + 2w_{pi})$ For $h_i \in [I.E._D, I.E._D + 2R]$

$V_{3i} = \triangle \cdot A_{sys} \cdot S$ For $h_i \in (I.E._D + 2R, I.E._D + 2R + Cov_D]$