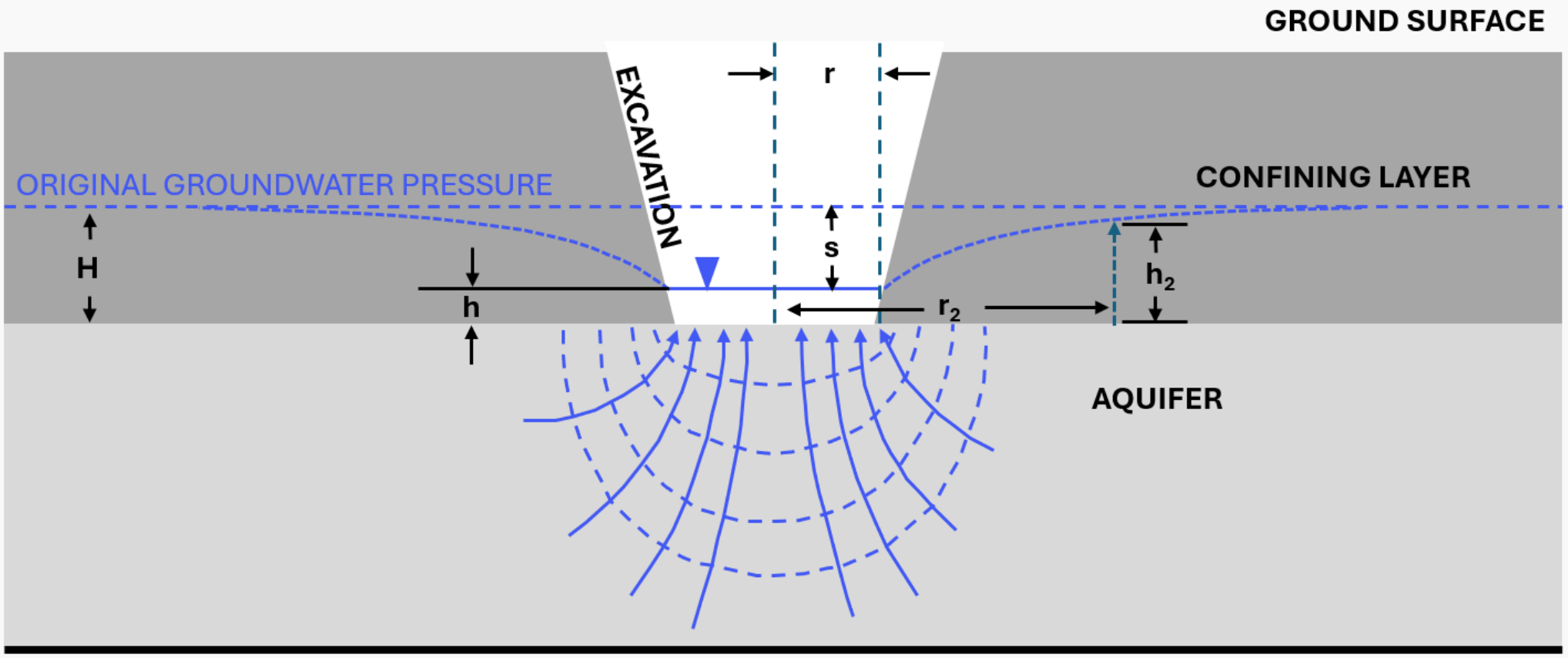
Aquifer Depressurizing Model by Equivalent Well Method

Application: Basal Seepage



Forchheimer Equation:

$$Q = 4Kr(H - h)$$

Flow Rate

Estimate pumping rate needed to control groundwater in excavation or pit.

Groundwater Head (h_2)

Approximate the new aquifer head at any distance (r_2) beyond the pit.

$$h_2 = H - \frac{Q}{2\pi Kr} sin^{-1}\left(\frac{r}{r_2}\right)$$

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When to use it

Use this method when groundwater enters a confined pit or excavation mainly through the base.

Typical applications include:

- Construction excavations penetrating a confined aquifer
- Basal seepage into cutoff-wall excavations
- Pit-lake inflow predictions

Limitations

- Best suited to square or nearly square excavations that can be represented by an equivalent circular radius. Avoid for long, narrow excavations.
- Assumes steady-state flow and homogeneous, isotropic aquifer conditions.
- Does not assess basal stability or how seepage water will be collected and removed.

What you need

Aquifer properties:

- Hydraulic conductivity, K
- Initial groundwater head, H
- Target groundwater head inside the excavation, h

Excavation geometry:

- Equivalent excavation radius, r

Equivalent Well Method

This method simplifies an excavation or pit as a large-diameter well, where side inflow is limited by cutoff walls or low-permeability geology and groundwater enters mainly through the base.

Model Equations & Variables

Flow Rate (Q)
Estimate the basal seepage flow rate entering the excavation through its base.

$$Q = 4Kr(H - h)$$

Groundwater Head (h_2)
Approximate the groundwater head at any radial distance outside the excavation.

$$h_2 = H - \frac{Q}{2\pi Kr} \sin^{-1}\left(\frac{r}{r_2}\right)$$

Symbol	Units	Description
Q	L^3/T	Basal seepage flow rate into the excavation
K	L/T	Hydraulic conductivity
r	L	Equivalent radius of the excavation or pit
H	L	Initial groundwater head outside the excavation
h	L	Target groundwater head inside the excavation
h_2	L	Groundwater head at radial distance r_2 from the excavation centre
r_2	L	Radial distance from the excavation centre to the point where h_2 is calculated