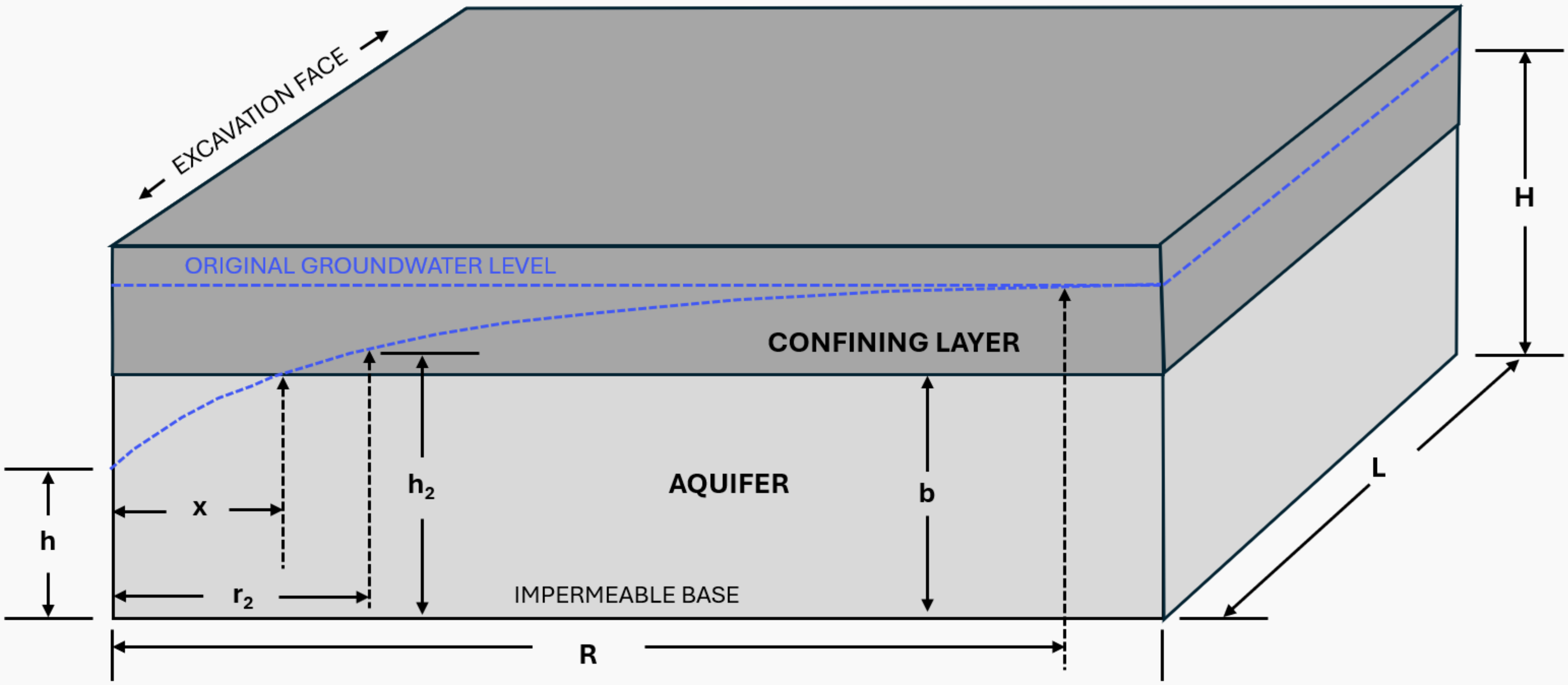
# Aquifer Dewatering Model by Slot Method

## Application: Mixed Aquifer




$$Q = \frac{KL\left(2bH - b^2 - h^2\right)}{2R}$$

→ **Flow Rate (Q)**

**Groundwater Head ($h_2$)** ←

$$h_2 = \sqrt{b^2 - \frac{x - r_2}{x}\left(b^2 - h^2\right)} \qquad \text{for } r_2 \leq x$$

$$h_2 = \frac{H - b}{R - x}\left(r_2 - x\right) + b \qquad \text{for } r_2 \geq x$$



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# Slot Method

This method simplifies a long excavation face as a pumped slot, where groundwater flow is treated as linear.

The equation estimates flow to one side of the excavation, so the result should be doubled to estimate flow from both sides. End effects can be modelled separately using a radial-flow equation.

These equations are commonly attributed to Chapman (1959).

# Model Variables

| Symbol | Units | Description |
|---|---|---|
| **H** | L | The initial groundwater head |
| **$h_2$** | L | Groundwater head at distance $r_2$ from the excavation face |
| **h** | L | Target groundwater head at the excavation face |
| **L** | L | Length of the excavation face |
| **$r_2$** | L | Distance from the excavation face to the point where $h_2$ is calculated |
| **R** | L | Distance of influence due to pumping measured perpendicular to the excavation face |
| **K** | L/T | Hydraulic conductivity of the aquifer |
| **b** | L | Aquifer thickness |
| **x** | L | Distance from the excavation face to the unconfined-to-confined transition point |
| **Q** | $L^3/T$ | Pumping rate to one side of the excavation |



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# Transition from Confined to Unconfined

The distance (x) where the aquifer transitions from confined to unconfined can be estimated as:

$$x = \frac{R\left(b^2 - h^2\right)}{2bH - b^2 - h^2}$$

## Model Variables

| Symbol | Units | Description |
|---|---|---|
| **H** | L | The initial groundwater head |
| **h** | L | Target groundwater head at the excavation face |
| **R** | L | Distance of influence due to pumping measured perpendicular to the excavation face |
| **b** | L | Aquifer thickness |
| **x** | L | Distance from the excavation face to the unconfined-to-confined transition point |



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## When to use it

Use this method when you need a quick estimate of dewatering flow and groundwater head change perpendicular to a long, narrow excavation where pumping causes the aquifer to transition from confined to unconfined conditions.

Typical applications include:

- Trench dewatering
- Long narrow quarries
- Proxy for streams or drains incised into confined aquifers

## What you need

Aquifer properties:

- Hydraulic conductivity
- Initial groundwater head (H), target groundwater head (h) and aquifer thickness (b)

Excavation properties:

- Length, width, and depth

## Limitations

- It is best suited to long and narrow excavations where the flow on the ends can be reasonably ignored.
- It can estimate groundwater head change around the excavation, but not inside it.
- The equation is steady state, so it does not account for aquifer storage effects, which can be important for short-term dewatering.

# Notes

## Distance of influence (R)

There are many equations available to estimate the distance over which dewatering effects extend. For radial flow, this is often called the radius of influence. For this linear slot-flow model, it is better understood as a distance of influence measured perpendicular to the excavation face.

What this distance represents in the real world is debatable, but in this model it is simply a mathematical boundary required for the calculation.

For this equation, the commonly suggested estimate is Sichardt's formula.

$$\textit{Sichardt Equation}\ [\textit{steady state}]\text{:}\ \ R = C(H - h)\sqrt{K}$$

Where C is typically 1500 to 2000 for slot-flow calculations when K is expressed in m/s.

## Further Reading:

*Chapman, T. G. (1959). Groundwater flow to trenches and wellpoints. Journal of the Institution of Engineers, Australia, October–November, 275–280.*